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EDITORIAL

The War. When the Great War ended in 1918 and armistice was signed, the saner section of the worlds' population believed that the last of the great wars in human history was fought once for all. The reclamation of devastated areas and the recovery of agriculture, industry and commerce took several years to attain the pre-war level. Indeed, the world has not, as yet recovered from the economic debacle which followed the great war. Despite this handicap, the last two decades have witnessed rapid strides in the sphere of science and industry in a manner never known before. Scientific progress has revolutionised human knowledge and has added greatly to the happiness of mankind in an imperfect world. When the world was thus slowly finding its level and returning to a state of prosperity, alas! greed and self-elation which has been brewing in the heart of Europe has suddenly seized the world again. The dogs of war have once again been let loose on peace-loving populations. The result is that precious human lives are being sacrificed, trade paralysed, peaceful industries brought to a stand still or diverted to the creation of weapons of destruction: agricultural commodities are cornered, the agricultural and industrial populations weaned from their peaceful avocations to fight against the whims of a dictator. The world has once again gone back to a state of tension and anxiety about the future.

Britain's unselfish choice to enter the arena in the defence of weaker nations in their struggle against aggression and domination by brute force deserves the warmest support of right thinking men the world over. We feel sure that in this crisis, India will, as she did in the past, stand by Britain and play her noble role in the creation of a new world order in which swords will again be beaten into plough-shares and tanks converted into tractors.

Agricultural Extension Work in America.

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History. Cooperative demonstration work radiating out from the Federal U. S. Department of Agriculture, Washington D. C. and in cooperation with the Agricultural Colleges in the 48 States of the Union, is this year celebrating its 25th anniversary in America. May I just briefly outline some of its aims and ideals in the hope that it may raise some thought as to whether an organization something similar in nature may not have possibilities for India too. This great movement in America arose in direct response to a real emergency in the rural life of the South where the cotton boll-weevil was threatening the very existence of the farmers in that area. Dr. Seaman A. Knapp, recognized as the founder of this great movement as well as the pioneer president of the Iowa State College, one of the leading colleges of agriculture in America, realized that the farmers and their wives and children had to be an organized body if they were effectively to meet the problems affecting their general welfare. In 1914, the U. S. Congress through the Smith-Lever Act, permanently appropriated funds for use in cooperation with the state colleges of agriculture, in giving instruction and practical demonstration in the best methods of farming and home-making to people on the farm.

Organisation. When this movement celebrated its 25th anniversary this year, it was reported that there were 4,121 country agricultural agents and assistants ; 2,142 home demonstration agents and 1,516 specialists engaged in this extension service to the rural population of America. Together with this staff paid from federal, state and local funds, is a small army of honorary, local leaders working under the guidance and instruction of these specialists and experts. These honorary leaders are really the backbone of the whole movement. At Washington D. C., in the department of agriculture represented in the U. S. President's cabinet, are numbers of specialists working in various departments guiding and directing the work of the 48 independent states. In each of the states, associated usually with the state college of agriculture, is the state extension service, comprising graduates in agriculture and home economics, specialists who again in turn go out on special programme as arranged by the leaders in the local counties and similar experts called county agricultural agents, home demonstration agents and boy and girl club leaders. A county would roughly correspond with a taluq in the Madras presidency. These county agents receive usually about half their salary from the State and Federal Government and half from local subscriptions and membership.

In addition to these are the rural consolidated high schools, with their departments of agriculture and home making, working more specifically with the boys and girls of high school age but also carrying on programmes of

work with the adults in the smaller community and in cooperation with their county agents in agriculture, home economics and club work. The Future Farmer clubs are specifically organized clubs for boys and girls who are taking recognized work in vocational agriculture and home-making with the intention of remaining in the rural area for work on their own farms and homes after graduation from high school. I got a great thrill attending the annual meeting of this fine organization at Kansas City, Missouri last year. More than 3,000 boys and girls attended this three day function.

The 4H club is a distinctive youth organization under the Extension department working with rural children ranging in age from 10 to 20 years emphasizing *head, heart, hand, health*, in their programme of work. The organization promotes the development of each of these vital activities in a young person's life. On the 25th anniversary of the organization, there were 1,286,029 members enrolled and approximately 7,500,000 boys and girls, young men and women in America who had received 4H club training since 1914. More than forty per cent of rural boys and girls old enough to enroll are today members of this great, nation-wide youth movement. I think you can see that they have done a great deal to revolutionize American rural life. I was tremendously impressed with this fact when we went around in the great rural areas of our country last year. This organization that emphasizes the training of the heart, head, hand and health, fits rural boys and girls in making the country a better place to live in. Better crops more efficient farms, nicer farm homes, and more attractive and healthful ones, more social activities and better recreation for the community as well as better fed boys and girls are some of its aims.

I was interested in attending an open forum discussion of some independant, local 4H club leaders when the topic for discussion was that of trying to evaluate the benefits they had received from club work. They listed such as the following:—

1. Self-reliance-knowing how to do a thing and being able to proceed without hesitancy or embarrassment.
2. Friendships-contacts and the ability to meet and mix with other people.
3. Better ability to perform everyday household-tasks in a practical and efficient manner.
4. Appreciation and desire for a nice, well-ordered home and ability to utilize products at hand to manage their families on an economical basis and within the range of their incomes.
5. Standardization and improvement of all classes of live-stock, better feeding and marketing, record keeping, formation of co-operative associations, and economical production of all classes of crops suitable to the area.
6. Appreciation of the value of social and religious organizations such as the church, the farm bureau, the consolidated school and their responsibility to further their respective interests.

The Extension department recognized that adult farmers could be persuaded to change their practices only with difficulty while boys and girls are more easily influenced to try new and improved methods and thus offer a fertile field for progress. Many thousands of these boys and girls do not have the opportunity of an education beyond that of the 8th standard, which is the lowest unit recognized in America, or possibly that of the High School or College, but through such club work, all can be partially trained to better fit them for rural life and living.

A Comparison with conditions in India. What is the situation in India along these lines? We have the Imperial Council of Agricultural Research with its interest in the development of agriculture on a national basis. Many of the provinces have excellent colleges of Agriculture with their affiliated research work often carried out in other centres in addition to the one connected with the main station at the college. In our Madras province we have the agricultural demonstrator at work in an area quite comparable to the County in America. Unfortunately, none of the American work for women is as yet organized in India in the same way as it is in agriculture for the men. Nor is anything of a similar organization found for the boys and girls, the youth of the nation and as such possibly the most responsive and the most important. Nor do we find the organization of the honorary non-official, local leader whom I have tried to describe as the backbone of the whole extension movement in America. Would not the work of the agricultural demonstrator be greatly heartened and made a hundred times more fruitful, if he would use more of his time in the training of such local leaders who would demonstrate effectively improved methods of agriculture and development? Alongside of it we should see the development of work among the women and even more urgent, that among the boys and girls and the youth in our villages. They after all are the hope of future India.

What the missions can do? What are we doing for such activities in our local Missions? To what extent are we reaching the thousands of young men and young women, boys and girls who will never have the opportunity of our Mission boarding schools? Are they not a sadly neglected group? Can we not organise clubs or groups, or Y. M. C. A's or youth organizations of some kind, call them what we will, to work along with the activities of the Church in the improvement of their homes, their ommunities, their family life, their social contacts, their income from the soil and cottage industries.

Research in Irrigation.*

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Introduction. Agriculture under irrigation plays a prominent part in the rural economy of this country and the consideration of its problems is of primary importance. The irrigation farmer offers the greatest scope for scientific and practical improvements and is thus of particular interest to the agricultural department. He can afford to do what the dry-land farmer generally cannot.

Except perhaps in the West Coast of this Presidency, there is no absolute security of harvest without some form of irrigation. For this reason, large areas are protected by irrigation works. Besides the protection afforded, irrigation increases the yield of crops and thus multiplies wealth.

The following figures reveal the importance of irrigated agriculture in this presidency. Of the 32 million acres cultivated, 9 million acres are under irrigation. The figures of 1937—38 show that the irrigated area is actually 27·3% of the total cultivated area. Up to 1935—36, the total capital outlay of the irrigation works was 1,521 lakhs and accumulated surplus returns 3,243 lakhs. The returns have thus doubled the outlay. The gross receipts for the year were 164 lakhs and the percentage of net return on capital outlay was 7·44 (8 & 9).

Present sources of irrigation. The ryot depends for water supply on three main sources, rivers, tanks and wells. As classified by the Irrigation Department, the following were the areas irrigated in 1937—38.

No.	Sources of irrigation.	Area in thousands of acres.
1.	Government canals	3,750
2.	Private channels	163
3.	Tanks	3,192
4.	Wells having indep dent ayacuts	1,359
5	Wells supplementing recognised sources of irrigation	255
6.	Other sources, i. e. spring channels etc.	281

As can be seen from these figures, the canals and tanks are of the greatest and almost equal importance while in other provinces, tanks are not so important as the canals. The tanks are as many as 35,000 in number. Next in importance are the wells which are 700,000 in number.

The great irrigation systems of this presidency are the deltaic ones of the Godavari, the Kistna and the Cauvery. By these, some 2·4 million acres of fertile deltaic lands enjoy the benefits of an assured supply of water. Examples of the great storage reservoirs in this province are the Periyar and the Cauvery-Mettur systems. The Mettur dam is expected to improve the existing supply for an area of 1·04 million acres and to bring in a new area of 0·3 million.

* Paper read at the M. A. S. U. Conference, July 1939.

The Maintenance of the present water supply. The first need for irrigated agriculture to thrive as an industry, is an assured supply of water, from the already existing sources of irrigation. This aspect is well looked after by the Irrigation Department. Fortunately the deltaic systems above mentioned, unlike in other provinces, do not present much of a difficulty in regulating the water supply.

But the maintenance of as many as 35,000 tanks and in some cases their restoration, present a problem which has been taxing the department concerned. It is a duty which the Government owes to the ryots, especially to the smaller cultivators, to keep these tanks in good repair, since over wide areas, the only source of irrigation is the conserved annual rainfall. The Irrigation Department has been quite alive to this aspect and the formation of an improved organisation to give particular attention to this aspect has been for a long time the concern of this department. Opinion is held that the gradual expansion of the system of Irrigation Panchayats for the management of Minor Irrigation works will not only give the Irrigation Department more scope for attention to the major works but will also prove beneficial in the long run to the cultivators themselves.

The maintenance of the existing wells is a matter that can be left to the cultivator, for he is himself immediately concerned with it and is bound to give his utmost attention to it.

Possibilities of expansion of irrigation sources. We now come to the problem of extending the sources of irrigation. Regarding the major works, this is one of great importance: because, firstly, the existing supplies are often insufficient to irrigate all the area under irrigation even for the first crop and additional supplies are needed for the cultivation of second crops which are now grown, if at all as 'dry'; secondly, protection is needed for those tracts where the threat of famine and drought is ever present viz. districts of Bellary, Cuddapah, Kurnool and Anantapur, and some parts of Coimbatore. The Tungabhadra and Bhavani projects are meant to protect these areas to a large extent and the Government have shown their utmost anxiety to complete these projects. The possibilities of extending the minor irrigation works wherever possible, which are of so much importance in this presidency, have always been under consideration.

We have next to consider the problem of extending well irrigation. The development of this source in the Madras Presidency has been one of greatest importance. In 1935—36, the total number of wells in Madras was 6,75,438 of which three districts, viz, North Arcot, Coimbatore and Trichinopoly contributed the largest numbers being in order, 1,18,933; 97,810 and 62,131. This development has been mainly due to the liberal policy of Government in exempting private improvements from additional taxation. Technical advice and assistance have always been forthcoming from the departments of Government. There is still scope for expansion in the number of wells, especially in the areas which do not have the benefit of

canal irrigation. The success of a well as a paying proposition, depends on the depth at which the subsoil water can be tapped and on the agricultural possibilities of the land to be irrigated. On these matters and on the best and cheapest methods of lifting water, the cultivator needs advice from the agricultural engineers and the agricultural department.

There is one other source of water supply which has possibilities of expansion i. e., irrigation from small streams by means of power-driven pumps placed on banks or temporary floats. This source can protect harvest over thousands of acres. The Agricultural Engineering Section is in the best position to devise cheap and efficient pumps with suitable platforms, combining low lift with high discharging capacity.

Need for irrigation research. There will soon come a time when the possibilities of constructing large irrigation works will come to an end and few new sources will remain to be exploited. When it does come, the chief problem will be (1) to make the available water go a longer way than it does now or in other words, the economic use of water and (2) to improve the irrigated areas so as to obtain better yields and better profits or in other words, land improvement.

The problem mentioned above will resolve itself into two broad lines, necessitating research :—

1. Lessening wastage of water.
2. Remedying defects that have become characteristic of irrigated lands, viz., water-logging and alkali problems.

Lessening wastage of water There are two ways by which this can be effected. One is decreasing the loss due to seepage in canals and another, economy in use of water.

Loss by seepage. This problem of loss of water by seepage from canals is one which has been engaging the attention of irrigation engineers for a number of years. It is a serious one ; because firstly, all the water lost is valuable water which could extend the area of irrigation, and secondly, it induces conditions of water-logging and concentration of salts, which are dealt with later. The seriousness of this factor of loss through seepage can be imagined when it is stated that the investigations made on irrigational canals in India have shown that in certain cases, the losses due to evaporation and seepage amounted to more than one half of the entire supply. The Punjab Irrigation Research Institute has been doing valuable work and experiments there have indicated that in certain specified cases, of common occurrence, seepage can be greatly reduced by treating the bed of the canal with sodium carbonate[4]. This method which does not involve high costs is under trial in other provinces.

Economy in use of water. It is universally admitted that there is enormous waste of water by cultivators in the canal irrigated tracts. In this connection, it has been a rule to contrast this with the sense of economy which the ryot employs when it is his well from which he irrigates his crops.

There are two main reasons as to why the cultivator does not economise the water from the canals:—

1. The assessment is by area and not by volume of water used.

2. There is the uncertainty of supply. He is unable to know at what intervals he will get his turns for water. Hence he attempts to make the best of it when he gets his turn.

The result is, there is wastage of water that could be profitably used otherwise. Assessment by area has therefore the fundamental defect that it offers no incentive to the cultivator to economise in the use of water. The ultimate aim should therefore be, to charge the cultivator by measurement of water he consumes for his crops. This aspect is one that has to be worked out by Irrigation Engineers and it involves several mechanical and administrative difficulties.

Distributaries in the Punjab have been fitted with meters functioning with modules, fixing the proportion of water taken from the canal and giving an even distribution from the head to the tail.[6]

However, as it stands now, the wastage of valuable water is not the only thing that matters: there is also definite damage to the soil. It is to this aspect that attention has to be directed even more particularly and the ryots have to be warned of the nature of damage. Over-irrigation and wasteful application of water produce harmful effects in several ways:—

1. Due to lack of aeration of roots, the ultimate yield of crop is lessened.

2. The soil gets impoverished through leaching and it deteriorates.

3. It spoils the climate, rendering it too humid and malarious. (1, 2 & 3).

For these reasons and to get the utmost benefit from water, either of the private well or of the public works, the cultivator must know the 'economic duty' for the crops he wants to raise.

Research in Madras. To this end in view, the Agricultural Department after having been consulted by the Irrigation Department, commenced in 1932—33, investigations on duties of water on a variety of crops viz. paddy, sugarcane, cholam, ragi and cambodia cotton. At first the work was to record the 'gross duty' of water for each crop. The record up to 1938 on the Central Farm [12] showed that the figures varied from season to season and two figures were not often alike as is evidenced by the statement below (Table 1).

In 1937, a more elaborate and more useful plan was drawn up, to conduct definite experiments, introducing variations to cover the following:—

(a) Cultural treatment and depth of each watering to be kept constant but intervals between waterings to be varied.

(b) Cultural treatment and interval between waterings to be kept constant but depths of individual waterings to be varied.

TABLE I. Irrigation experiments on the Central Farm, Coimbatore. Statement of water consumption of crops.

Year	Ragi.			Cambodia Cotton.			Chitrai Cholam.		
	Quantity of irrigation water in acre inches	Quantity of rain-fall during crop period in acre inches.	Total quantity of water in acre inches.	Quantity of irrigation water in acre inches.	Quantity of rain-fall during crop period.	Total quantity of water in acre inches.	Quantity of irrigation water in acre inches.	Quantity of rain-fall during crop period in acre inches.	Total quantity of water in acre inches.
1933				8·69	19·02	27·71	5·0	8·21	13·21
1934	23·87	1·59	25·46	8·19	12·31	20·50	13·78	7·99	21·77
1935	14·76	3·24	17·60	9·99	12·64	22·63	17·83	4·03	21·86
1936	15·40	5·44	20·57	12·97	10·98	23·95	14·13	4·60	18·73
1937	18·30	5·25	23·55	7·91	7·51	15·42	10·32	7·76	18·08
1938							16·07	3·15	19·22

(c) Cultural treatment and the depth in inches per day to be kept constant but actual depths and intervals to be varied, e. g. $\frac{1}{5}''$ per day given in one or other of the following ways:—

1″ in 5 days
2″ in 10 days
3″ in 15 days

(d) The study of combined effects of variety, spacing, manures and water-supply on the yield of crops.

On these lines experiments have been commenced in Aduturai, Maruteru, Paddy Breeding station and Central Farm, Coimbatore.

Even in reviewing a year's work, some tangible indications are noted. For instance, experiments on Ragi were conducted on the Central Farm[12] with four variations in interval of irrigation viz. one week, two weeks, three weeks and four weeks and three variations in depth of irrigation, viz. 2 inches, 3 inches and 4 inches. Statistical analysis (vide Tables II, III, IV & V) revealed the following:—

1. In the case of interval, with regard to grain, there was no significant difference between three weeks and four weeks, but within the other variations, the more frequent the irrigation, the higher was the yield.

With regard to straw, within the four variations, more frequent irrigation gave higher yield.

2. With regard to depth, in both the cases of grain and straw, 3 inches and 4 inches were better than 2 inches but 4 inches was not better than 3 inches.

The results of such experiments are of immense value to the ryots and that they do realise it, is seen from the fact that no experiment on the farm has evinced so great an interest from the neighbouring and visiting ryots as this set of experiments.

Results of Irrigation Experiments on Ragi (1938-39), Central Farm, Coimbatore.

TABLE II. Grain-yield. Interval variations.

Particulars.	Mean yield of Intervals.				General mean.	Whether general effect of treatment is significant by Z test. P=0·05.	Standard error of Mean per plot.	Critical difference for significance. P=0·05.
	1 week.	2 weeks.	3 weeks.	4 weeks.				
Yield in decagrams per plot.	1630·5	1432·25	954·75	952·75	1242·56	Yes.	19·72	63·06
Yield in pounds per acre.	1676·2	1472·4	981·5	979·4	1276·52			
Percentage over general mean.	131·4	115·3	76·9	76·7	100			

Conclusion—1 week>2 weeks>3 weeks=4 weeks.

TABLE III. Grain-yield Depth variations.

Particulars.	Mean yield of depths.			General mean.	Whether general effect of treatment is significant by Z test. P=0·05.	Standard error of Mean per plot.	Critical difference for significance. P=0·05.
	2 ac. in.	3 ac. in.	4 ac. in.				
Yield in decagrams per plot.	375·63	436·88	430·06	414·19	Yes.	9·19	26·81
Yield in pounds per acre.	1156·94	1345·6	1324·58	1276·52			
Percentage over general mean.	90·6	105·4	103·8	100·0			

Conclusion—3 ac. in.=4 ac. in.>2 ac. in.

TABLE IV. Straw-yield Interval variations.

Particulars.	Mean yield of Intervals.				General mean.	Whether general effect of treatment is significant by Z test P=0·05.	Standard error of Mean per plot.	Critical difference for significance. P=0·05.
	1 week.	2 weeks.	3 weeks.	4 weeks.				
Yield in quarter pounds per plot.	515·5	446·25	308·00	265·5	383·81	Yes.	9·62	30·77
Yield in pounds per acre.	5997·84	5192·12	3583·54	3089·09	4465·53			
Percentage over general mean.	134·3	116·3	80·4	69·2	100·0			

Conclusion—1 week>2 weeks>3 weeks>4 weeks.

TABLE V. Straw-yield. Depth variations.

Particulars.	Mean yield of depths. 2 ac. in.	3 ac. in.	4 ac. in.	General mean.	Whether general effect of treatment is significant by Z test P=0·05.	Standard error of Mean per plot.	Critical difference for significance P=0·05.
Yield in quarter pounds per plot.	104·5	136·44	130·38	127·94	Yes.	3·14	9·16
Yield in pounds per acre.	3647·47	4762·30	4550·78	4465·53			
Percentage over General Mean.	81·7	106·6	101·9	100·0			

Conclusion—3 ac. in. = 4 ac. in. > 2 ac. in.

It may be argued that to translate these results, especially regarding optimum depths, accurately under ryots' conditions will be impossible. We have to admit that we cannot think of the possibility of controlling the depth or quantity of water accurately to the crop requirements in a ryot's field. But such a difficulty applies equally to a case of spacing, say in paddy. If experiments have proved that 9" is the best spacing between plants, surely, this accurate spacing cannot be maintained under a ryot's field conditions. After all, in practical working, what is required is, near about optimum conditions, after it is known what exactly are 'optimum conditions'.

In this connection, an extract from Aduturai Station Report of 1937—38,[11] regarding experiments on paddy states :—

"The results clearly indicated that the application of 1 in. water at four-day intervals or 2 in. at eight-day intervals gave the best yield. So the universal practice of bunding up water to a depth of even 6 in. to 8 in. in paddy fields is a very wasteful method, conferring no benefit to the paddy grower. If the *mirasdars* could be induced not to let in more than 2 in. or at the most 3 in. of water at every irrigation, a great volume of water now wasted, may be kept back in the reservoir from the month of October onwards for ensuring a plentiful supply in the following June to start the new paddy season with."

It is clear from the above extract how a definite conclusion of the kind mentioned above can be put into practice with profit.

Water-logging and formation of alkali lands. A review of the history of irrigation development has shown, that many of the troubles of which the above are the most important, have been due to unfavourable conditions of soil, water-supply and drainage, which were not realised before development was started. The causes were a lack of knowledge regarding,

1. the soil characteristics that contribute to success under irrigation,
2. the quality of irrigation water,
3. the need for effective drainage.

Success could be achieved by a rational classification of land for irrigation based on two factors, viz.,

1. The soil must not contain excessive quantities of alkali salts.
2. Special care should be taken to ascertain that natural drainage particularly below ground, is adequate or that adequate artificial drainage can be provided at a reasonable cost.

Also information as to the quality of water should be complete. For, irrigation water, unlike rain water, contains dissolved substances, often in substantial quantities. These substances accumulate in the irrigated soil and may in time cause vast changes in its character. It is interesting to note that irrigation water during a season's crop in some cases has been estimated to contain as much as a ton of dissolved solids to an acre[5]. The harm that could be done by excess of salts can be understood when it is remembered that the maximum safe quantity of soluble salts as manures is only about 300 lb. per acre. Existence of injurious salts in the water will, therefore be definitely dangerous.

Thus where the potentialities of injury of either kind exist, remedial measures may be taken often at small expense. It is more difficult to deal with it after it has developed.

These difficulties were earlier realised in the U. S. A. and Egypt. It is for these reasons that the Royal Commission on Agriculture[6] laid down that before new projects are initiated, the agricultural department ought to be consulted fully, with regard to the suitability of the soil for irrigation, the conformation of the subsoil, the nature of the crops that would be grown and the character of supply that would be required for them. An instance of this co-operation is the Tungabhadra project where investigations on these lines have been undertaken on the Research Station at Siruguppa.[10]

Such co-operation between the two sister departments will undoubtedly contribute to the general prosperity of the country.

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Cashewnuts.*

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Introduction. The cultivation of money crops in an agricultural holding, however small it be, is a question of necessity. For, it is with the money thus realised that the cultivator is able to purchase necessities of life other than those produced on his farm. Unfortunately these commercial crops besides taking the most fertile bit of his land require more money as well as care for their successful cultivation and preparation for market. Among a few exceptions to this category cashewnut stands foremost. It thrives well on lands where no other crop will grow. Once the plantation is started it requires no further care, such as cultivation, manuring or preparation of the produce for the market. In fact a cashewnut plantation is as good an asset as a sound dividend-paying investment.

Known by different names in the languages of the province - *kappalandi* in Malayalam, *gerubeeja* in Kanarese, *mundirikottai* in Tamil and *gerupappu* in Telugu—cashewnut (*Anacardium occidentale*. Linn) is familiar to every Indian household though it is not an article of staple diet. In foreign countries it is in great demand, especially in the United States of America and United Kingdom, who are the largest consumers of the commodity in the world. A hitherto neglected crop the Indian cashewnut has slowly but steadily captured the foreign market. The setback received during the Great War has been overcome and the trends of the trade assure a bright future. The magnitude of the cashewnut industry in India can be well understood from the fact that the annual export value exceeds Rs. 115 lakhs giving employment to 10,000 to 16,000 people in the season and west coast plays an important part in production and trade. The cultivator and the commercial man have not as yet realised fully the economic importance of the industry even though it gives a commodity classed all the world over as a delicacy and offers several other economic by-products. The Indian production is far below the foreign demand. To engage the men and the machinery of the industry for a greater part of the year large quantities of African nuts are imported every year by the factory owners in India and as much as 17,000 tons of raw nuts have been imported during 1936—37. So

* Paper read at the M. A. S. U. Conference, July 1939.

there is scope to extend the cultivation of cashew in the waste lands of some districts of the east and west coasts of this presidency. The object of this paper is to create interest in those who feel like taking up this industry and furnish them with information on all aspects.

Original home and habitat. The cashewnut is believed to be a native of South America. It was introduced into India by the Portuguese for the main purpose of checking erosion on the sandy coasts of the peninsula. It has got thoroughly acclimatised in this country and is growing wild on the west coast from Cape Comorin to Bombay. It is also found cultivated on a small scale on the east coast districts of Vizagapatam, Godavari, Guntur, Chittoor, Chingleput, North Arcot, South Arcot, and Tanjore. Outside India it is met with in tropical America--from Mexico to Brazil, east and west coasts of Africa, Madagascar, Indo-china, Malayan peninsula, Philippine Islands and Ceylon.

The plant. The cashewnut tree is a tropical evergreen growing to a height of thirty to fifty feet depending on the fertility of the soil. It grows well even on very poor soil and is one of the hardiest drought-resistant plants. There are several types of trees exhibiting variations in the season of bearing, shape and colour of the fruit, size, shape and weight of the nuts, whiteness and hardness of the kernel, etc. The cashewnut tree has more seasons of growth than one. The first vegetative flush appears in summer following the fruiting season. A second but a very moderate flush is put forth during the middle of July, when heavy rains are received. The third or the main flush is in November and in a month's time the flower panicles appear. The fruits are formed in summer and the nuts gathered from February to May.

Cultivation. (i) *Soil and Climate.* The tree is capable of thriving under widely different conditions of soil and climate. Though systematic cultivation and manuring are not usually given, yet the tree has been observed to respond to such treatments. The plant grows best on light sandy soils and on the shallow laterite slopes as well. In South Kanara, Malabar, Cochin and Travancore it grows on red laterite soil under a rainfall of about 120 to 150 inches and equally well on the sandy tracts of the east coast having a rainfall of about 35 inches. In the west coast districts and in the states of Cochin and Travancore cashewnut occurs on hill slopes mixed with other trees. But the Konkan farmers of Bombay are inclined to believe that the cashewnut trees have a peculiarly exhaustive or toxic effect on the soil and that no crop will flourish in the neighbourhood of cashewnut trees. Consequently only waste lands and hilly places unsuitable for other crops are mainly utilised for its cultivation.

(ii) *Sowing.* Selection of seednuts plays an important part in the successful raising of a good cashewnut plantation; generally medium sized heavy nuts are preferred for sowing. In some places like Ceylon seedlings are raised in nurseries and transplanted, but they do not stand transplanting well probably because the tap root gets damaged during the process. The general practice in the west coast is to sow seeds 'in situ' in the south-west

monsoon, in pits 1′ × 1′ × 1′ size, twenty to twenty-five feet apart depending upon the nature of the soil. Sometimes even 150 to 200 trees are grown per acre. But the optimum is about 100 trees per acre.

(iii) *Growth and Bearing*. No further expenditure is incurred in the after cultivation of the garden except for fencing the plantation for the first two years to protect the young plants from the ravages of cattle. The trees begin to bear after a period of three years and continue to yield for a period of fifteen to twenty years. There are, however, plants which have given good yields even up to thirty years. Thereafter they exude a gummy substance, which renders them unfruitful. On the west coast, the flowers appear from December to February. The fruit is developed on the pyriform succulent fleshy body, formed by the thickening of the fruit stock or pedicel and becomes ready for harvest in two to two and a half months. It is noticed on the west coast that the bearing is maximum in the year when there is a long and hot summer showing thereby the existence of a definite relation between weather conditions and the setting of flowers.

(iv) *Harvesting*. The fruits with the 'apple' are plucked in February, March and April by coolies engaged for the purpose with a long bamboo having a hook at the tip. Economic yields are obtained from the seventh or the eighth year. The yield varies from fifteen to forty pounds of nuts per tree. Either the owner harvests and sells the produce or lets out on contract the usufructory rights when the harvesting has to be done by the purchaser. The latter method is more convenient although it involves a certain amount of risk to both the parties.

(v) *Pests and Diseases*. The only important disease which attacks the cashewnut tree is the "Die-back disease". This has been recently found in a virulent form in certain localities of the west coast causing great loss by the complete drying of the trees. No insect pests of importance have been noticed so far attacking the cashewnut tree.

The Economics. The total expenses in bringing up a garden is more or less negligible and the only sum that has to be invested is mainly for the purchase of the land, sowing and fencing. Apart from the cost of the land the other expenditure may come to Rs. 10 to 13 per acre till the trees come to bearing. For the first five years of bearing, an average of fifteen pounds of nuts per tree may be expected to be obtained and there after twenty-five pounds per tree. In addition 100 to 150 lb. of "apple" will be obtained from each tree per year. The number of nuts per pound varies from 60 to 150 on the west coast and 30 to 125 in Ceylon. The east African nuts are smaller than those of the west coast. The present market price for the unshelled nut is Rs. 1—12—0 per thulam of 37½ lb. in Malabar i. e., nine pies per pound. Generally the ryots sell the nuts locally to the middlemen. Sometimes the ryots find markets locally for apples also and the usual rate is one anna per hundred. It is found from the following table that a net income of Rs. 70 to 90 could be obtained from one acre of good plantation, if the nuts are disposed locally unshelled.

Cost of cultivation for one acre of 100 trees till bearing.

	Rs.	A.	P.
Making 100 pits	1	8	0
Seednuts—200	0	4	0
Sowing	0	2	0
Fencing and repair	10	0	0
Earthing up the trees	0	4	0
Lease for three years	12	0	0
Total.	24	2	0

This sum of about Rs. 25 is the capital investment for cultivating a garden of one acre for the first three years and the interest on it is negligible.

Annual average expenditure per year of the first five years of bearing.

Harvesting charges	18	12	0
Lease amount	4	0	0
Miscellaneous	1	0	0
Total.	23	12	0

Annual average income per year of the first five years of bearing.

1500 lb. nuts (15 lb per tree) at Rs. 1—12—0 per thulam.

Annual average income per year for the first five years of bearing.

1500 lb of nuts (15 lb. per tree) @ Rs. 1—12--0 per thulam	70	0	0
Less expenses	23	12	0
Net profit.	56	4	0

The disposal of apples is not certain in all years and it may not add anything to the income.

Annual average income per year after the eighth year of planting.

2500 lb of nuts	116	10	8
Total expenses	23	12	0
Net profit	92	14	8

In some places tender nuts are in demand and they fetch about one and a half to two annas per 100. Small quantities of unshelled nuts are also exported to foreign countries. South Kanara nuts are considered to be inferior in quality to the Malabar and Goa nuts.

Processing or curing of the cashewnut. The exportation is mainly of cured nuts and the curing of nuts forms a cottage industry on the west coast. There are also several factories engaged in the curing of cashewnut and they buy nuts at Rs. 7 to 7—8—0 for a bag of 130 lb. of nuts. The centres of curing are Mangalore and Rajahmundry in Madras, Quilon in Travancore state, Malvan and Goa in Bombay. The process of curing involves several operations like roasting, shelling, peeling, sweating, grading and packing.

(i) *Roasting.* The nuts are uniformly dried and roasted in open iron pans three feet by two feet in size, over mud furnaces stirring vigorously all the time to ensure uniform roasting. Occasional sprinkling of water is necessary to prevent the shells from getting charred. Generally the cashewnut shell itself is used as fuel. The nuts are spread out on the floor after this operation. Two men can roast about 6720 lb. of nuts per day of six

hours. The oil on the nuts is completely dried by sprinkling ash over it; otherwise being caustic it blisters the skin. While roasting a certain amount of oil is obtained which fetches one anna per bottle locally.

(ii) *Shelling*. The shelling is generally done by women on contract system at four pies per pound of kernels obtained. Each woman will shell nearly 16 to 20 lb. per day. The kernels obtained by shelling will be 25% to 30% of the whole nut and out of this kernels 75% to 89% will be 'wholes' and 11% to 25% will be 'brokens'.

(iii) *Peeling*. The kernels obtained after shelling are either sun-dried or dried properly over a furnace in wire gauze trays at 70 degrees centigrade and the outer skin is removed, which will be nearly 10% to 15% of the whole kernels. The drying also facilitates the removal of moisture from the kernels. The usual rate for peeling on the west coast is four pies per pound of 'wholes' and two pies for 'brokens.' Usually women coolies are employed and they earn five to six annas per day.

(iv) *Sweating*. Slight sprinkling of water is done after peeling to prevent splitting and breaking of kernels during transit.

(v) *Grading*. For the convenience of marketing, the kernels are graded into four classes as—

1. Good big kernels
2. Good small kernels
3. Splits and brokens
4. Rejects and spoils

Grading also is done by women and one woman will sort 55 to 69 lb. of kernels per day of six hours earning four to five annas.

(vi) *Packing*. The kernels are packed in small sized tins containing 25 lb. of kernels in each. The tins are vacuumised and sometimes filled with carbon dioxide, which is found to be the best method to stand storage for periods extending even up to eight or ten months. The kernels are also locally sold at the rate of five to six annas per pound for 'wholes' and three to four annas for 'brokens.'

Cost of production of 100 lb. of kernel in the factory.

	Rs.	A.	P.
Nuts 390 lb. @ Rs. 7—8—0 per bag of 130 lb. ...	22	8	0
Roasting ...	0	10	0
Shelling (4 ps. per lb.) ...	2	7	0
Peeling (Do.) ...	2	1	4
Grading ...	0	6	0
Miscellaneous expenditure ...	1	7	8
Total. ...	29	8	0
100 lb. of kernels if sold locally @ 5 annas per lb. ...	31	4	0
Shell oil (10% giving 25 lb.) ...	1	0	0
Total. ...	32	4	0
Less expenses. ...	29	8	0
Net profit. ...	2	12	0

Thus a profit of Rs. 2 to 3 is obtained in disposing produce as kernels instead of selling as whole nuts.

The products and their utilisation. The best economical return with minimum cost of production is a unique feature in growing cashew. Every part of the tree is useful and valued by the people and the by-products obtained from it seem to be popular in modern markets.

(i) *Tree.* The tree as a whole is used as a good source of firewood throughout the west coast. The wood is used for the preparation of charcoal and for making country boats and packing-cases. The resinous gum which exudes from the bark of the tree has well known insecticidal properties and is also used as a tanning agent. The sap obtained from the incisions on the bark is utilised as an indelible marking ink. The gum being insect proof can be used in book-binding.

(ii) *Nut.* (a) *Kernel.* In Europe cashewnut kernel is considered as a dessert nut and it is used frequently in making confectioneries. "Americans are eating more cashews than they used to" says the Bureau of Agricultural Economics. In the west coast the kernels from tender nuts are used for *curries, payasams,* etc. The kernels contain a large amount of protein as can be seen from the following figures :—

Analysis of kernels.

	%
Protein	14·43
Ash	2·80
Fat ..	4·56
Fibre	1·27

(Brain, C. K.)

The kernel, just like almond and walnut, forms a common ingredient of many varieties of cakes and sweetmeats which are popular in western countries. The following table gives a comparison of cashewnut with almond and walnut and justifies its name— "the tropical almond."

TABLE I. The Chemical analysis.

(H. H. Mitchell and Jessie, R. Readles).

Description of nuts.	Moisture %	Crude protein %	Ether extract %	Crude fibre %	Nitrogen free extract %	Ash %	Calcium %	Phosphorus %	Gross energy in calories per gm. (Bomb calorimeter)
Cashewnut fresh	4·39	19·52	48·70	1·20	23·72	2·47	0·041	0·507	6·48
Almond bleached	4·56	21·94	56·75	3·34	10·29	3·12	0·251	0·527	6·76
English walnuts fresh	4·39	21·16	61·91	2·35	8·07	2·12	0·096	0·463	7·32

From the above table we find that there is not much difference between the three kinds of nuts in their chemical constituents. The true digestibility and the biological value of the three nut proteins is given below :—

TABLE II

(H. H. Mitchell and Jessse. R. Readles).

Source of protein	True Digestibility %	Biological value
Cashewnut	96·23±0·16	72·50±0 66
Almond	93·95±0·23	50·84±0·37
English walnut	84·11±0·22	55 89±0·92

It may also be stated that cashewnut has been declared to be superior to almond or walnut in its true digestibility coefficient and biological value. Its nutritive value is further enhanced by the presence of vitamins A and B_2. The kernel gives a light yellow, bland oil which is very nutritious and forms 40% of the kernel. As a substitute for almond oil, this oil can be used with much advantage in pharmaceutical preparations. The thin pinkish coloured testa or seed coat together with the broken kernel tips forms a good poultry feed. The analysis of the mixture is as follows :—

	%
Water	8·1
Protein	7·6
Fat	12·3
Carbohydrates	59·2
Fibre	11·0
Ash	1·8

(Joachim).

The nutritive value of this feed is very high giving a ratio of 1 : 11·5.

(b) *The shell.* The cashewnut shell oil which is 29% of the shell is reddish brown in colour and is esteemed as a valuable commodity in the market. The constituents of the oil are anacardic acid, gallic acid, and cardol. Though the shell contains 29% of oil, only 10 to 15% is obtained by the ordinary extraction. A ton of cashew shells on destructive distillation gives 6,000 cubic feet of gas of a calorific value which compares very favourably with coal gas. The charcoal obtained is one-third of the shell and has a calorific value of local coal. Its use as smokeless fuel is suggested. The oil is used in the preparation of different kinds of varnishes, moulding compositions, insulating coatings, inks, etc. The oil is known for its use as a preservative for boats and fishing nets and it has got the most valuable property of preventing termite attack. It is believed that the oil is a good valuable specific against certain forms of leprosy and other skin diseases. It is reported that this oil with kerosene or high speed diesel oil in the proportion of 1 : 19 can be used for killing the larvae of mosquitoes.

(iii) *Cashew apple.* The swollen pedicel called the apple is generally eaten by the poor classes on the west coast. The juice of the apple which is about 65% of the weight of the fruit, can be fermented either to yield a beverage or to produce vinegar. The juice gives the following analytical figures :—

pH. value	4·2 to 4·6
Total solids	10·6%
Ash	0·36%

(Srinivasan).

Out of the 10·6% of the total solids of the juice 94% is sugar, the remaining parts being acids, tannins, pigments and an astringent principle.

	%
Acidity in grammes of sulphuric acid	0·28
Reducing sugars	11·96
Non-reducing sugars	0·66
Total sugars and traces of pectin	12·62

(Sayed).

From the above analysis it is found that the juice contains a large percentage of invert sugars, which is nearly, 7% of the fresh weight of the fruit. The juice can be converted into a syrup to preserve the invert sugars, which are noted for their suitability for inclusion in infant and invalid foods. The juice is sometimes used as a remedy for dysentry because of its high tannin content. When mixed with iron sulphate it makes an excellent hair dye. The fruit is also eaten as a remedy for scurvy since it contains vitamin C.

Export and import. Due to the recent fillip received by the growing popularity of the cashewnut in the confectionery trade of America and Europe an increased demand in foreign countries is observed, and this has resulted in the present export trade of Indian cashew kernels. Refering to previous years there was a lull in the trade in 1914 due to the Great War. But further rise was observed after 1920. It is an accepted fact that India takes the monopoly in the production of cashewnuts. The progress of the export trade is much better understood from the following table:—

TABLE III. Cashew kernels exported from India in millions of lb.

Year	To U. S. A. Shippable	To Europe and other countries & consumed in India.		Total.
		Shippable	Non-shippable	
1925	1·5	1·00	0.25	2·75
1926	2·5	1·25	0·37	4·12
1927	4·0	1·50	0·55	6·05
1928	5·0	1·25	0·67	6·92
1929	7·5	2·00	0·95	10·45
1930	8·5	2·00	1·05	11·55
1931	9·0	2·50	1·15	12·65
1932	9·7	2·80	1·25	13·95
1933	11·3	2·70	1·40	15·40
1934	15·0	3·50	1·85	20·35
1935	23·0	5·50	2·85	31·35
1936	30·0	5·00	3·50	38·50

From the above table it is understood, that the export trade of cashew kernel in India has made steady progress from 1925 onwards and total export has increased from 2·75 million pounds in 1925 to 38·5 million pounds in 1936. These figures clearly show that the Indian cashewnut industry is slowly capturing the market and there is yet considerable scope for the extension of the markets in Europe and India. It is recorded that India produces now more than 33,000 tons of nuts and in addition imports more than 17,000 tons of nuts from foreign places like Kenya colony, Tanganyika, Portugese East Africa. etc. The export trade has rapidly developed along the several centres of the west coast of India, of which Mangalore was the chief. But now Cochin is considered to be the chief

exporting centre, while South Kanara is the largest producing centre. Bombay is another centre in India. Alleppy is the port of shipment in Travancore and the exports reach nearly 20 lakhs of pounds of kernels. Bombay stands only next to Madras in the export and import trade of cashewnut as can be seen from the following table :—

TABLE IV. Statement showing the quantity and value of cashewnuts imported into Madras and Bombay Presidencies from foreign countries during 1936-37.

Country of consignment	Madras Presidency		Bombay Presidency	
	Quantity	Value	Quantity	Value
	Tons	Rs.	Tons	Rs.
Kenya Colony	159	19,527	414	57,384
Tanganyika Territory	...	...	32	3,654
Portuguese East Africa	9,788	12,82,602	5,832	7,45,020
Union of South Africa	1,087	1,45,569	...	...
United Kingdom	1	900	...	...
Ceylon	...*	62	...	...
Total.	11,035	14,48,660	6,278	8,06,058

* Less than 1 ton (about 3 cwt.)

TABLE V. Statement showing the quantity and value of cashewnut kernels exported from Madras and Bombay Presidencies to foreign countries during 1936—37.

Country to which shipped.	Madras Presidency		Bombay Presidency	
	Quantity.	Value.	Quantity.	Value.
	Tons.	Rs.	Tons.	Rs.
United Kingdom	582	6,09,766	69	64,450
Maldives	(a)	110	...	...
Ceylon	(a)	38	...	...
Straits Settlements	10	8,929	...	...
Federated Malay States	6	4,681	...	...
Union of South Africa	15	16,970	...	...
Commonwealth of Australia	36	19,100	...	...
Canada (Atlantic Coast)	158	1,89,095	...	...
New Zealand	16	19,687	...	...
Finland	3	3,875	...	...
Sweden	14	12,310	(a)	360
Belgium	156	1,13,540	79	66,400
France	322	2,28,729	5	4,540
Netherlands	40	40,875	8	6,995
Germany	7	6,059	...	...
U. S. A. (Atlantic Coast)	6,724	78,97,190	1,088	11,36,965
U. S. A. (Pacific Coast)	710	8,00,613	143	1,58,213
Palestine	...	...	1	1,350
Norway	...	...	(a)	50
Other States in Arabia	...	...	(a)	280
Total.	8,799	99,71,567	1,393	14,39,603

(a) Less than 1 ton in each case.

Thus out of 10,192 tons of kernels exported, United States of America alone consumed: 8,665 tons, United kingdom 649 tons, Canada 158 tons,

France 332 tons, while the other countries shared the remaining 402 tons. As regards the quantity of imported nuts is concerned, Madras gets nearly double the quantity than that of Bombay.

TABLE VI. Import trade of cashewnut from the foreign countries during the last three years.

Year	Foreign Imports.				Total	
	Madras		Bombay			
	Tons	Rs.	Tons	Rs.	Tons	Rs.
1934—35	11,925	13,83,640	+	+	...	...
1935—36	12,764	16,80,836	3,532	4,43,846	16,296	21,24,682
1936—37	11,035	14,48,660	6,278	8,06,058	17,313	22,54,718

It is understood from the above table that the importation is more or less stationary for the last three years. Hence more local production of cashewnuts is required to meet the needs of the factories whioh control the oversea's trade.

Future of the Industry. Though India has got the monopoly of the cashewnut trade in the foreign markets, it is rather strange to observe that such an advantage is not properly utilised for the further development of the industry. Importation of cashewnut from Africa indicates only the scarcity of nuts for the Indian factories. At present we have got only about two dozen factories mostly distributed on the west coast. It can be anticipated that in the future we may have to face keen competition in the cashewnut industry from other tropical countries and this must be considered a potential threat against the present industry, especially of our presidency. Hence it is time for us to take proper steps for the advancement of the industry. The Agricultural Department of Bombay presidency has recently been conducting scientific researches on this valuable and nutritious product. The authorities of the Canal Zone Experimental Gardens have introduced for trial several varieties of cashew.

With the increasing importance of the cashewnut it was felt that a systematic study of the crop was necessary and a modest beginning in this direction was made by the Oil Seeds Section of this Department. A block of five acres of sandy soil was planted to cashewnuts in 1931—32 at the Agricultural Research Station, Nileshwar No. III, South Kanara district. The early growth was good and more than half the number of plants flowered in the third year. Various observations were and are being made to gain a better insight into the growth and yield complex of the plant. A large number of one to three years old seedlings have been examined for their roots and it has been found out that the cashewnut has a remarkably well developed root system, much better than most of the other fruit trees. Studies in germination, seednut and seedling selection, etc., are in progress and the results are awaited with great interest. More than 11,000 lb. of selected seednuts have been distributed by the Oil Seeds Section during

the last six years, and at a conservative estimate at least 300 acres must have been planted with these seeds.

Though our presidency and the neighbouring states lead in the production of cashewnut, very little is being done for the development of the industry. Therefore it is essential in the interests of our presidency and also of the Indian cashewnut industry, that the cultivation is widely extended and new markets for this nutritious and useful product be developed in other parts of the world, especially in the British Empire. An improved cashewnut industry is an asset and the following steps if taken in time will surely go a long way in establishing this industry on a firm and secure foundation.

(i) The department should do more propaganda for inducing ryots to plant their waste lands with cashewnut trees.

(ii) The ryots may be permitted to grow cashewnut trees in government porambokes and waste lands.

(iii) To evolve better yielding and disease resistant types and for finding out new industrial uses for cashew by-products scientific investigations should be undertaken and the government should finance new schemes of research in the above direction.

(iv) Cooperative societies should be started for better marketing.

(v) The provincial governments should be induced to address the Central Government for fixing standard grades for marketing.

(vi) By propaganda and publicity new markets should be created abroad.

(vii) When the internal supply of nuts has sufficiently increased to meet the needs of the factories, suitable tariff regulations or legislative measure must be adopted to prevent the import of nuts from foreign countries.

It is learnt from a recent Government communique that the Government have approved of a scheme of the Forest Department for planting cashewnuts in unreserves of South Kanara District, and have sanctioned the appointment of the necessary staff for the purpose. This definitely shows that the Government are fully alive to the importance of the cashewnut cultivation.

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The Scope of Pillipesara (*Phaseolus trilobus*) in the Solution of the Fodder Problem.

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Introduction. In the feed of animals, carbohydrates, proteins, fats, minerals and vitamins are the most important constituents. While the straws of the various cereals are the main sources of dry fodder upon which an ordinary ryot falls back for the maintenance of his livestock, the value of a proper ration of green food especially to milch cows and young growing stock is not for a moment to be minimized. Digestible green forage gives all that an animal physiologically needs. Grasses of pasture lands, sorghum, maize, sunnhemp, and *pillipesara (Phaseolus trilobus)* are the chief sources of green fodder. To these may be added exotic crops like guinea and elephant grasses, and lucerne *(Medicago sativa)* all of which are, however, confined in South India to the neighbourhood of agricultural research stations. The cultivation of grasses for fodder requires devoting to them, permanently or for a long period, of a sufficient plot of land which the great mass of ryots cannot afford to. The village pasture grounds where the cattle of the place graze are not only insufficient but incapable of affording grazing during the warm dry months of the year when the need for green forage is felt most. Sorghum, and to a less extent maize are grown in certain parts of the South for cutting and feeding green to cattle. The surplus, if any, is generally dried and made into hay and stacked for later use. The same is the case with sunnhemp in Kistna, Guntur, and parts of Godavari

and Vizagapatam. These are good so far as they go. But *pillipesara* seems to have for all practical purposes certain advantages over the rest of its kind. It continues to remain on the field green and succulent over a long period or until it is ploughed in, when it serves as green manure. The same cannot be said in the case of others. They are to be cut at the flowering or seeding stage and either made into hay or converted in good time into silage if the benefits of green fodder are to be preserved. Being a slender spreading fodder crop, the fibre content in *pillipesara* does not get increased after the seeding stage to the extent of rendering itself poor or useless as in the case of sunnhemp. Its thin seed pods which are usually fed or grazed with the stalks and foliage are much relished by cattle and therefore the valuable nutrient material in the seed is not lost. Further, along with sunn-hemp and lucerne it stands in the happy company of leguminous crops which are known to build up the nitrogen content of the soil in which they are grown through the formation of root-nodules by the relative nitrogen-fixing bacteria.

Cultivation as a pure crop. Among the known fodder crops, *pillipesara* is perhaps the most easily grown. Moisture-retaining clay soils accommodate the crop best, although all soils ranging from clayey to loamy will amply meet its requirements. Its habit being of a creeping nature, it is conveniently sown in a variety of ways either as a pure crop or mixture. For a pure crop in wetland, seeds at the rate of 20 to 25 lbs. are sown two or three days before the harvest of paddy and no aftercare is required except to make out a few drains where it is thought necessary to remove the excess water. This aspect should always be kept in mind in order to facilitate good germination. If, however, water-logging conditions exist at about the time of harvest of paddy, sowing of pillipesara should be deferred till after paddy is harvested and the excess of water in the field drawn off. When the soil is still moist, the seed should be sown broadcast and a brush harrow or a moderately heavy levelling-board run over is sufficient to effect good germination. In both the cases it will be seen that ploughing is dispensed with and moisture in the soil, as much as could be retained compatibly with the requirements of good germination, is conserved and utilized for the future growth of the crop. In many villages, low-lying wetland, in which no *punasa* or *pyru* crops are or can be grown on account of the heaviness of the soil, is at present being left uncultivated after taking a single paddy crop. It is quite possible and highly desirable that *pillipesara* is sown in such areas and the fodder problem in the villages thereby relieved.

Cultivation as a mixed crop. *Pillipesara* may also be grown mixed with *pyru* gingelly. After paddy, the land is ploughed three or four times, and some time in January, gingelly seed is as usual sown broadcast immediately followed by *pillipesara* seed at the rate of 12 to 15 lb. per acre. Both the seeds are then covered by ploughing twice. By the time gingelly is harvested after about three months, *pillipesara* grows sufficiently well and will be the only crop on the field, till again paddy comes in. Besides, it is

advisable to sow pillipesara wherever is possible, e. g., in gardens allowing sunlight within, such as of coconut, mango, and other fruit trees, on field bunds of paddy, and in pasture lands. It will be enough in such cases if the seed is sown once in two years at the beginning of the rains. Grass mixed with *pillipesara* is highly relished by cattle, besides the fodder thus obtained being larger in quantity.

Harvest and Yield. In about two months from the time of sowing, *pillipesara* will be ready for its first cutting, the exact period depending upon the moisture content of the soil. The crop may then be either cut and fed to or directly grazed by cattle. At the beginning, care should be taken to adjust the quantum of feed as animals suddenly turned to new appetizing foodstuffs are likely to consume more than they are able to digest. In moisture-retaining heavy soils or with the aid of one or two timely showers or irrigations, *pillipesara* yields upto 30,000 lb. of green fodder per acre. But in lighter soils and under adverse circumstances the yield may go down as low as 10,000 lb. To maintain one grown-up animal, 25 cents of land will be required, on an average, to be sown with this fodder crop.

Conclusion. In most of the villages facilities for irrigation during the hot months are few; as such, irrigated fodder crops are seldom attempted by the cultivators. But *pillipesara* comes in handy in many ways to solve the fodder problem in a large part of South India. Will all those interested in rural uplift look around and see whether or not this humble vagrant weed can be brought to supply cheap and efficacious fooder usually so scarce?

[*Pillipesara* has been successfully grown for fodder and as a green manure crop on the Agricultural Research Stations at Guntur, Nandyal, Hagari, Pattukottai, Aduturai, Maruteru, and Coimbatore, and yields of green stuff ranging from 7 to 86 thousand pounds per acre have been recorded.—*Editor, M. A. J.*]

SELECTED ARTICLE

The Principles of Manufacturing Fruit Juices.

(*Translated by N. K.*)

The manufacture of fruit juices, not only of fruits like pineapple which were long established, though in restricted distribution, but also of fruits like the tomatoes, has risen up very much during the last eight years. Circular 344 of the Agri-experiment Station of the University of California (Berkeley Cal.) gives very exact information for the Industrial preparation. For small scale industries the *Revue Agricole de l'Isle de la Reunion* vol. 43. 1938: p. 212—215 may be referred. Apart from these the conservation of the fruit juices has been specially treated in the *Bulletin of the Imperial Institute, London* 36. 1938: p. 334—349 and in the *Malayan Agricultural Journal* 26.1938:472—477. The basic principle of the whole of the fruit juice preparation is the retention of the aroma and taste of the original fresh fruit to the utmost possibility. The conservation of the nutritive value of the juices becomes secondary when compared with the preservation of the vitamins (B and C) contained in them. The rest of the nutritive materials —sugar, acids, mineral salts—are capable of staying and do not get spoilt during the process.

The industrial preparation falls under the following phases:—Choice and preparation of the fruits; extraction of juice; clearing of the juice with a view to improve its appearance and conservation. There are special machines for each kind of fruit variety. Throughout the process of the manufacture all contamination with air must be avoided because specially in the citrus fruits the quality gets spoilt and vitamin C is destroyed through oxidation. Since complete exclusion of air during the manufacture is not usually possible, towards the end of the process the juice is freed from air through vacuum. As far as possible all contamination with metals is to be avoided. The instruments and apparatus must either be of glass or of metals coated with glass or at least of rust free metals (aluminium, nickel, certain copper-nickel alloys or stainless steel).

In the choice of the fruits it must be borne in mind that not all fruits nor all the fruits of one variety are suitable for extraction. It is imperative to choose only healthy, ripe, uninjured fruits. Storage should be as far as possible avoided, since the staying power of the individual fruits may vary. The fruits must be washed with great care, particularly in case any fungicidal or insecticidal chemicals have been used. In view of the machines used the fruits must be graded through a wire sieve. The following tropical and subtropical fruits are of special importance in fruit juice manufacture.

1. *Citrus varieties.* In the first place comes grape fruit; next comes the tangerines and tangelos*. Orange and particularly lemon are very difficult to preserve, the latter is manufactured in small quantities for the sake of perfumeries and confectionaries, while the orange juice is mostly replaced by the concentrates. Varieties and the condition of the ripeness are of very great importance. In California the Valencia oranges come to market from April-November but are used in the juice manufacture only for 6 weeks.

2. *Passion fruit (Passiflora edulis).*

3. *Pomegranates*—This gives a juice which in a pure state is very sharp or acid, but is best suited as a blend for other juices.

4. *Grapes*—The various labuska varieties are preferred to all other and secondly in mixtures coloured juices are preferred. The acidity should be high.

5. Pineapple.

In the extraction of the juice the admixture of the other fruit contents, must be avoided. It is the worst method to extract the juice from the halved citrus fruits through rotating on ribbed and similarly constructed extractors. In the passion fruit the juicy flesh of the fruits with the seeds are removed from the cut fruits usually by a rotating press (burring). For the separation of the seeds a particular method of pressing is necessary which is attained in the extractors by a forward running screw. In the pomegranates the edible portion is confined to the berry-like arils or fruit bodies, because the rest of the fruits are too rich in tannins. The extraction of the grape juice is very laborious because it is necessary to remove the colour which is difficultly soluble in the cold. This is done through heating the completely or partially pressed out juice with the skin and finally pressing it out again. In the case of the colourless grapes heating is not only unnecessary but even injurious.

Clearing. While formerly a completely cleared juice was preferred, now-a-days such a thorough clarification is considered not desirable since many of the small particles that are present in the juice are held to be of primary importance for the taste and the nutritive value. Thus for the orange juice the yellow chromatophores present are decisive. Of course the suspended particles should

* Tangerine is a loose jacket orange (mandarin). Tangelo is a hybrid between Tangerine and Pomelo. (Translator's note.)

not be too large and the correct amount allowable is hard to estimate. Larger particles such as the seeds, pieces of skin or the fleshy portion of the fruit must be always removed (sieved). Besides these, there remain finer particles as also the gum and pectin substances in colloidal form. The first are removable through decantation or sieving or filtering and the latter through precipitation with gelatin and tannin (on the average 1·25 oz. tannin and 1·5 to 6 oz. gelatin for every 100 gals), through dissolution by enzymes and through coagulation by heat or cold. In the case of the grape juice the removal of the tartarates is effected by repeated crystallisation, by supersaturating the solution, by heat or cold, the second of which is quicker.

The most important preserving or conserving method is pasturisation. This is conducted in two ways, through heating at low temperatures for a long time or a short heating at a higher temperature. The second method the so called lightning-pasturisation, has certain advantages, because the juice after a long heating is not palatable. The juice is heated for 10 seconds to 1 minute at 185 -190°F. (85--88°C) and then cooled to a temperature suitable for pouring into the containers and filled, closed and quickly cooled down. Care is to be taken that the whole of the juice is heated through and through which depends upon the medium of heat (steam transfers the heat slower than water), the difference in temperature between this and the juice, the thickness and structure of the vessel and lastly on the nature of the juice itself (the viscous juices conduct heat slower than thinner ones). In America a special process called the 'Stero-vac' which combines the heating, quick cooling and exhaustion of air, is used.

Further conserving methods are the freezing, the Matzka-process and a few other less important methods. The freezing is the most ideal process but is beset with great difficulties. Moreover all the micro-organisms which would destroy the fruit juices will not be killed so that on rewarming deterioration may set in and the juice will have to be stored always frozen. The Matzka process combines the lightning-pasturisation and the sterilisation through metallic silver which process depends on the killing effect of the oligodynamic working of the metal on the organism. This method is used in U. S. A., Canada, Sicily, Holland etc. The chemical preservatives are sulphurous acid (as sulphur dioxide or potassium bisulphite) and sodium benzoate. Their presence should be indicated in prominent letters on the labels.

As vessels for the fruit juices, formerly almost exclusively glass alone was used. Now in general are preferred cans made of specially treated tin (pure tin has a bad effect on the fruit juice). In this for each kind of fruit juice separate cans are prepared (e. g. for the citrus juice the so called citrus enamel lined cans). The filling in after pasturisation shall be done in as warm a condition as is possible. For sterilising the fastener it is advisable to turn the vessel up side down or laying it on its side.

Among the special preparation methods mention may be made of the manufacture of fruit syrups and the concentrated fruit juices. Fruit syrups are mostly from citrus juices. The preparation consists in the addition of sugar (at least 7 lb. for every gallon), citric acid, and terpene free citrus-skin oil (also a little fruit-flesh may be added). Concentrated fruit juices may be looked upon as special conserving process. These are prepared by concentrating the juice either in vacuum or through freezing. The former runs very quickly from the surface of thin layers and the heating which could become injurious to the juice is thereby avoided. At first a careful separation of the particles of the fruit flesh is necessary otherwise the concentrated juice would become too viscous and difficult to handle. The concentration through freezing (Kraus-process) depends upon the principle that when a solution is cooled below the freezing point of water a portion of the water of the solution is converted into pure ice

and the concentrated solution could be thus separated. This process is gone through repeatedly with special apparatus twice or thrice. In order to improve the staying power of the concentrate it is still necessary to increase the percentage of dry substances of the completed products by about 60–65 % with the addition of sugar.

For the preparation of the juices in smaller quantities for household uses or for local distribution the following method according to the *Revue Agricole de Reunione* may be employed. The fruits shall be invariably cleaned well with a horse hair brush in warm water (50–60°C.) before use and dried. The juice is obtained, in the citrus fruits, by cutting them into halves (rust-free steel knives) and pressing out the juice with a usual lemon press; in the case of the pineapple the skin and scales are removed and separated from the fibrous materials and cut into pieces in a purree mill (mashing mill). Filtration is not necessary. Sieving through a gauze is enough. The gauze should be boiled before use, for about 10 mins. The juice is filled into bottles with porcelain and rubber-ring fasteners (beer or lemonade bottles) which have been carefully cleaned and pasturised. In the latter the bottles are at first kept open in a water bath (naturally the water must not enter the bottle) and the temperature brought to 60°C. then the corks are put on and the bottles immersed in the water and temperature raised to 65–70°C. by adding hot water. They should remain here for about 20 minutes. After 24 hours, the pasturising must be repeated (65–70°C. for 20 mins). Care must be taken that the given temperature is reached in the interior of the bottle also. To determine this it is better to place a bottle filled with water along with them and the water temperature estimated. The highest temperature given should be under no circumstances exceeded.—*Troepnpflanzer* 42 (1939); 219.

EXTRACTS

Effect of Fertilization upon Quality of Sugarcane. By cane quality or "quality ratio" is meant the ratio of cane to sugar yield, or the number of tons of cane required to produce one ton of sugar.

In order to see how fertilizers affected the quality ratio a compilation was made of all cooperative field experiments made in the Hawaiian Islands from 1930 to 1936, inclusive, which have been concerned with the determination of optimum amounts of nitrogen, phosphate, and potash. These experiments included 289 nitrogen, 300 phosphate, and 298 potash tests. The results are shown as relative quality ratios for all the islands in terms of averages.

Nitrogen.

Lb. N Applied	Quality Ratio (average 8·91)
50	8·79
100	8·77
150	8·84
200	8·89
250	8·99
300	9·03

Phosphate and Potash.

Lb. P_2O_5 or K_2O Applied	Phosphate (Average Q. R. 8·96)	Potash (Average Q. R. 9·18)
None	8·93	9·24
1—100	8·95	9·18
101—200	8·96	9·15
201—300	8·98	9·15
Over 300	8·98	9·19

In the light of these results it appears reasonable to conclude that increased applications of nitrogen fertilizer are apt to result in a cane growth that will have a poorer quality; however, under conditions existing in Hawaii there is lack of sufficient proof that juice quality has been affected to any great extent by the application of either phosphate or potash fertilizers. If in individual cases phosphate or potash seem to affect quality it will be well to look for an affiliated causal relationship. (*Facts about Sugar* 34 (1939): 34—35).

A Tip to Sugarcane Growers—Value of Dry Farming. A practical grower aims at vigorous and uniform germination of sugarcane setts. Experiments have shown that temperatures below 50°F. are injurious to germination. It is a mistake to plant the setts too deep in the soil. In the Bombay-Deccan, the favourite method is to irrigate the fields and press the setts down into the soil with the foot, after which two short period irrigations, every four or five days, are given. Except in soils newly brought under cultivation, these irrigations have been found to be superfluous and when dropped the rate of germination has accelerated by 80 per cent. Dry planting gives much better results. The setts are placed in position in the furrows with just sufficient dry soil to cover them. The furrows are then irrigated with a slow flow of water for the first three or four times of watering till the soil at the sides settles down, after which the system of normal irrigation is followed. This system gave 60 percent germination even with the unfavourable temperature of 1934 and under normal conditions gave 70 to 80 per cent. It has been conspicuously successful in soils with bad tilth (the so-called chopan) of the Bombay-Deccan. The presence of dry scale leaves on the buds of the sugarcane also affects germination. The difficulty can be overcome partly by rejecting setts with dry-scaled buds and partly by using sulphate of ammonia at the time of planting. Some varieties e. g., E. K.—28, possess a large number of dry-scaled buds and require such assistance. There has been some discussion as to whether a sett should contain one, two or three buds. The three-budded setts are the best, probably owing to the additional reserve material in the larger sett.

Chemical studies show that there is no correlation between the amount of glucose in the sett and germination, though there appears to be some correlation between germination and the easily available nitrogen in the sett. The main factor is the amount of water in the sett: hence the improved germination which results from soaking them in water or lime solution. Soaking is advantageous only in areas where irrigation is not in vogue; in irrigated areas, it does not appear to be necessary. (*Indian Information Series*, Vol. 5, No. 33, page 68).

Gleanings.

Pineapple Propagation. A new method in Sierra Leone. In March this year (1938), the writer attempted a new way of utilizing pineapple stems for propagation which has given very promising results. The stem was stripped, cleaned in the usual way and cut *longitudinally* instead of transversely, into quarter slices. Thus slices exposed a large outer bud bearing surface, each slice bearing its own reserve of food from the interior of the stem. The inner surface of the pith was then pared flat and the slices placed outersurface uppermost upon a nursery bed of well-forked soil and humus and pressed half-way into the soil. It was found that within a week, the stronger buds had swollen and in three weeks little plantlets, strong in character, had developed. As soon as these were large enough (4 to 8 weeks), the plantlets were cut away with a small piece of the parent slice, the suckers by that time having become well equipped with rootlets. These plantlets required further nursing until old enough for their permanent

place in the field. After the first crop of suckers was removed the slices were replaced in the nursery for the further development of plantlets.

Plants which are in an advanced stage of fruiting are unsuitable for propagation by this method. It has been found that the best time to cut the stem is, when the plant is fully grown and just about to flower; after that the rate of multiplication declines. During the rains, germination, although somewhat slower, is quite successful. Shade is unnecessary during the rains, but is advantageous during the dry months.

The slices may be soaked in permanganate of Potash as done in St. Lucia, to prevent ants attacking them when placed in germination beds. They should not however, be covered over, but left exposed for the free development of buds. The preparation of the nursery presents no difficulty and is simply a well-forked soil with the incorporation of well-rotted humus of well decomposed cow manure. (*Tropical Agriculture* 16: 192).

Soil decomposition of a plant pathogen. Several fungi which attack plants from the soil disappear when the host is not grown for a certain period. S. D. Garret of Rothamsted Experimental Station, has made a study of this action with *Ophiobolus Graminis*, the fungus causing 'take all' disease of wheat (Ann. App Biol. 25, No. 4, 742; 1938). The fungus apparently disappears as a result of natural decomposition by other micro-organisms of the soil. It will remain alive indefinitely in air-dry soil, at low temperatures of 2—3°C. and under sterile conditions. Decay of *Ophiobolus* mycelium is quickest when conditions are such that the normal micro-flora of the soil is greatest. Addition to the soil of energy materials lacking nitrogen, such as glucose or starch, hastens the destruction of Mycelium, whilst dried blood with readily available nitrogen, has the opposite effect. Soil conditions which are least favourable for the parasitism of O. *graminis* may, in fact, best preserve the organism during the non-pathogenic phase. *Nature* CXLIII (1939): 526.)

Orange Oil. Oranges grow in abundance in the plains of the Punjab and their production is showing a steady increase. According to the figures supplied by the Marketing officer of the Department of Agriculture, the production during the year 1934—35, of two principal varieties of oranges, namely Malta and Sangtara, was 5,24,256 and 7,11,271 maunds respectively. Hitherto these oranges were mostly consumed in eating, but recently the production of orange squashes etc., has been started on a small scale in the Punjab The orange fruit is known to yield some other useful products as well, but these have not so far been extracted from it. The most important of them are orange oil and pectin; orange oil finds use in confectionery for flavouring as well as in perfumery and medicine. Pectin is used for the manufacture of food jellies. Local and foreign markets exist for both these products. With a view to study the possibilities for their production from the Punjab fruits, work was undertaken by the Department of Industries at its Industrial Research Laboratory in Shahdara. It has been found that the Punjab orange generally yields good quality orange oil and pectin. The preparation of pectin may be a little difficult matter, but orange oil from the peels can be extracted easily by the hand sponge process as used in Italy which consists of pressing the peels between the two fingers of the hand and receiving the oil in a sponge from which it is later on removed. This method can be easily followed in Punjab homes by women-folk. The oil can also be recovered from peels by steam distillation in an ordinary distillation still. One and a half maunds of fresh peels yield by the latter method about one pound of oil at a total cost of Rs. 3—12—0. The local price of the oil is quoted at Rs. 5—0—0 per lb. Samples of the oil prepared in the Industrial Research Laboratory were sent to the various local dealers and consumers, all of whom have reported favourably about its quality. The industry is particularly suitable for firms which are engaged in

the preparation of orange squashes—one such manufacturer at Amritsar has already started the extraction of orange oil. Last season he prepared about 50 lbs. of oil the whole of which was consumed locally in the manufacture of soda water, fruit, and other essences. In those areas of the province specially the colonies, where orange peels can be collected easily and cheaply, the production of orange oil will be found to be a profitable industry. (*The Nagpur Agricultural College Magazine*, XIII, 4, 1939).

Iodine as an essential plant nutrient. Influence of iodine has been studied in water and soil cultures at Oregon Agricultural Experiment Station beginning in 1929. Crop indicators used in experiments include alfalfa, clover, peas, corn, lettuce, tomatoes and sunflowers. Mathematically significant increases in yield have been obtained, especially with alfalfa (lucerne), clover and lettuce, while germination has been stimulated with corn. Iodine seems to promote development of chlorophyll of green pigment in plants. Soil micro-organisms appear to be affected, particularly nitrogen-fixing legume root bacteria. Yeasts are known to be stimulated by iodine. Favourable concentration in flowing culture solutions is found to be one-fourth to one-half part per million. Flowing solutions were connected in series by Waldo Carlson, Graduate Assistant, who found the age of solutions affected stimulation and older solutions were more beneficial. The iodine may change to organic form before it is effective. With alfalfa in "sterile" culture this concentration was inhibitive, an indirect effect is indicated. James C. Lewis, Graduate Assistant, found stimulation from iodine in soil cultures using a soil well supplied as to total iodine. Two to four pounds of iodine as potassium iodide were found to be significantly stimulating in soil cultures with Aiken and Deschutes soil series. Other soils have given negative results. Even where increase in yield was small the iodine content of the plants has been increased manifold according to analyses by Mr. Lewis.

Comparison of methods for iodine determination has been made in the laboratory of Dr. J. R. Haag, Nutrition Chemist. Some improvement has been made in adopting the Harvey procedure for analysis of soil and plant materials.

Oregon soils, waters and plants are frequently low in iodine, yet certain deep wells, lakes and soils are found to be well supplied. Iodine in Oregon soils may run from ½ part to 15 parts per million. The iodine content of Oregon waters is from ·01 to 20 parts per million. The relation seems sharpest between iodine content of water and goiter. Soil iodine seems to accumulate with organic matter and to be higher in soils of sea-bed origin. Baumann in 1895 found absence of iodine in plants affects thyroid. Asd in 1903 recommended seaweed as fertilizer, due to its iodine content.

According to a map of the United States prepared by Dr. J. F. McClendon there is a high incidence of goiter in certain areas, including much of the Pacific Northwest. Head lettuce and spinach are among the plants that contain relatively more iodine. Marine by-product fertilizers afford a source of iodine. Small scale field trials are being made this season. If successful, potassium iodide might be added in irrigation water and large seed may absorb sufficient amounts for plant needs. (*Science* Vol. 89, No. 2315, May 1939. Pp. 434, 435).

Correspondence.

To

The Editor, Madras Agricultural Journal.

Sir,

A note on the use of cellophone for the use of posters and charts.

The ordinary cellophone paper which is more extensively used in view of its transparency for wrapping all commercial wares, is found to be a very good substitute for glass, in framing pictures and posters for exhibition purposes.

There is this added advantage—being a paper. the risk of breakage is totally eliminated. The cost is considerably low but it has all the advantage of glass, in giving a clear view of the contents inside.

The paper could be cut to any size and gummed back to the cardboard board, fixed in the reverse of the poster. This method which has been tried by me has been found to be quite good. It has been possible to protect the posters from the silver fish danger for a fairly long period. This method I venture to suggest could be substituted in place of others, for protecting the frames and posters against silver fish damage.

C. Jaganatha Rao.

Agricultural Jottings.

(From the Director of Agriculture, Madras.)

TIRUVOTTIYUR MILCH CATTLE MARKET

Market Report No. 6.

Madras, Friday the 11th August 1939.

Arrivals continue to be meagre. The quality of Ongole cows is rather poor. Country buffaloes of average and good classes are available. There was a brisk sale of Delhi buffaloes and the stock is diminishing. Generally an upward trend is noticeable in the price of buffaloes as compared to last week.

The following gives the stock movements during the week ending 10th August 1939.

	Stock at commencement.	Arrivals.	Sales.	Balance at the end.
Cows-Ongole	70	82	56	96
Buffaloes-country	204	130	111	223
Buffaloes-Delhi	38	24	52	10

Age.	Milk yield.	Prices From	Prices To
Prices :			
1. Cows-Ongole.			
1st and 2nd calving	2—3 Madras measures	100	120
	3—4 " "	no stock	
2nd and 3rd calving	2—3 " "	60	100
	3—4 " "	no stock	
2. Buffaloes-country.			
1st and 2nd calving	2—3 " "	80	100
	3—4 " "	110	130
2nd and 3rd calving	2—3 " "	60	80
	3—4 " "	80	100
3. Others.			
Buffaloes-Delhi		150	220

(1 Madras measure of milk = 4 lb.)

Market Report No. 7.

Madras, Friday the 18th August 1939.

Arrivals of both cows and buffaloes have increased during the week. A few cows of Delhi, Scindhi and Cross breeds are also available. Better types of Ongole cows have now arrived. A slight decline is noticed in the prices of both cows and buffaloes due to increased arrivals.

The following gives the stock movements during week ending 17th August 1939.

	Stock at commencement.	Arrivals.	Sales.	Balance at end
Cows-Ongole	96	125	102	119
Cows-crossbred		not available		4
Cows-Delhi	...	...	...	2
Cows-Scindhi	...	22	...	2
Buffaloes-country	223	191	129	285
Do. Delhi	10	20	12	18

Prices:

Age.	Milk yield.	Prices ranging. From	To
		Rs.	Rs.
1. Cows-Ongole			
1st and 2nd calving	2—3 Madras measures.	90	110
	3—4 " "	110	130
2nd and 3rd calving	2—3 " "	60	90
	3—4 " "	90	100
2. Buffaloes-country			
1st and 2nd calving	2—3 " "	70	90
	3—4 " "	100	130
2nd and 3rd calving	2—3 " "	50	70
	3—4 " "	70	100
3. Others.			
Buffaloes-Delhi		150	200
Cows-Delhi		100	150
" -Scindhi		100	150
" -Crossbred		100	800

(1 Madras measure of milk = 4 lb.)

Market Report No. 8.

Madras, Friday the 25th August 1939.

Number of cows and country buffaloes that arrived was less than in the previous week. Sales of both country and Delhi buffaloes are on the increase. Prices show a slight increase in the case of buffaloes.

	Stock at commencement.	Arrivals.	Sale.	Balance at end.
Cows-Ongole	119	114	73	160
Buffaloes-country	285	138	160	263
Buffaloes-Delhi	18	40	34	24

Prices;

Age.	Milk yield.	Prices ranging From	To
1. Cows-Ongole.			
1st and 2nd calving	2—3 Madras measures.	90	110
	3—4 " "	110	130
3rd and 4th calving	2—3 " "	60	90
	3—4 " "	90	100

2. Buffaloes-country.			
1st and 2nd calving	2—3 " "	70	100
	3—4 " "	100	130
3rd and 4th calving	2—3 " "	60	80
	3—4 " "	80	110
3. Others.			
Buffaloes-Delhi		150	200
Cows crossbred		150	200

(1 Madras measure = 4 lb.)

Market Report No. 9.

Madras, Friday the 1st September 1939.

While the arrivals of country buffaloes were on the increase only a few of Delhi buffaloes arrived during the week. Sales of both cows and buffaloes were on the increase. Prices were generally steady.

The following gives the stock movements during the week ending 31st August 1939.

	Stock at commencement	Arrival.	Sale.	Balance at end.
Cows-Ongole	160	104	139	125
Buffaloes-country	263	162	220	205
Buffaloes-Delhi	24	5	17	12

Prices:

Age.	Milk yield.	Prices ranging From	To
1. Cows-Ongole.			
1st and 2nd calving	2—3 Madras measures	90	110
	3—4 " "	110	130
3rd and 4th calving	2—3 " "	60	90
	3—4 " "	90	100
2. Buffaloes-country.			
1st and 2nd calving	2—3 " "	70	100
	3—4 " "	100	130
3rd and 4th calving	2—3 " "	60	80
	3—4 " "	80	110
3. Others.			
Buffaloes-Delhi		150	200
Cows crossbred		150	200

(1 Madras measure of milk = 4 lb.)

Market Report No. 10.

Madras, Friday the 8th September 1939.

Arrivals of country buffaloes were heavy and those of Delhi buffaloes nil, during the week, while the quality of country buffaloes is good, the Ongole cows available at the market are poor. The prices of both cows and buffaloes tend to decrease slightly.

The following gives the stock movements during the week ending 7th September 1939.

	Stock at commencement.	Arrivals.	Sales.	Balance at end.
Cows-Ongole	125	96	109	112
Buffaloes-country	205	236	149	292
Buffaloes-Delhi	12	...	5	7

Prices :

Age.	Milk yield.	Prices ranging From	To
1. Cows-Ongole.			
1st and 2nd calving	2—3 Madras measures	80	100
	3—4 ,, ,,	no stock	
3rd and 4th calving	2—3 ,, ,,	60	80
	3—4 ,, ,,	80	90
2. Buffaloes-country.			
1st and 2nd calving	2—3 ,, ,,	60	80
	3—4 ,, ,,	90	90
3rd and 4th calving	2—3 ,, ,,	55	75
	3—4 ,, ,,	75	100
3. Others.			
Buffaloes-Delhi		120	175
Cows-crossbred		150	200

(1 Madras measure of milk = 4 lb.)

Market Report No. 11.

Madras, Friday the 15th September 1939.

Arrivals of Ongole cows have increased while those of country buffaloes have fallen down. Delhi buffaloes are not being imported. Ongole cows of superior quality available now at the market has considerably improved. Prices are steady.

The following gives the stock movements during the week ended 14th September 1939.

	Stock at commencement.	Arrivals.	Sale.	Balance at end.
Cows-Ongole	112	116	52	176
Buffaloes-country	292	147	159	280
Buffaloes-Delhi	7	...	...	7

Prices :

Age.	Milk yield.	Prices ranging From	To
1. Cows-Ongole.			
1st and 2nd calving	2—3 Madras measures	80	100
	3—4 ,, ,,	100	130
3rd and 4th calving	2—3 ,, ,,	60	80
	3—4 ,, ,,	80	100
2. Buffaloes-country.			
1st and 2nd calving	2—3 ,, ,,	60	90
	3—4 ,, ,,	90	120
2nd and 3rd calving	2—3 ,, ,,	55	75
	3—4 ,, ,,	75	100
3. Others.			
Buffaloes-Delhi		120	150
Cows-crossbred		150	200

(1 Madras measure of milk = 4 lb.)

Crop and Trade Reports.

Statistics—Crop—Sugarcane—1938—Intermediate condition report. The sugarcane crop has been affected by drought to some extent in Kistna, Chingleput, South Arcot, Chittoor, North Arcot, Madura, Ramnad and Tinnevelly. The condition of the crop is satisfactory in the other districts of the Province and normal yield can be expected if the season continues to be favourable.

The wholesale price of jaggery per imperial maund of 82$\frac{2}{7}$ lb. (equivalent to 3,200 tolas) as reported from important markets on 4th September 1939 was Rs. 9—14—0 in Adoni, Rs. 8—7—0 in Mangalore, Rs. 7—12—0 in Rajahmundry and Vellore, Rs. 7—9—0 in Vizagapatam, Rs. 7—6—0 in Cocanada and Chittoor, Rs. 7—4—0 in Salem, Rs. 6—12—0 in Cuddalore, Rs. 6—10—0 in Vizianagaram, Rs. 6—7—0 in Erode, Rs. 6—3—0 in Trichinopoly, Rs. 6—0—0 in Bellary and Rs. 4—15—0 in Coimbatore. When compared with the prices published in the last report i. e., those which prevailed on 9th August 1939, these prices reveal a rise of approximately 13 per cent in Mangalore, 12 per cent in Vellore, 3 per cent in Vizagapatam, Trichinopoly and Chittoor and 2 per cent in Rajahmundry and a fall of approximately 6 per cent in Bellary, the prices remaining stationary at the other centres.

Subject: Statistics—1939-40—Cotton—Intermediate Forecast Report. *Last Year's Crop.* The yield of the second or summer pickings of the 1938-39 crop is estimated to be below normal.

Current Year's Crop. The main season for sowing is not yet over in most parts of the Province. Sowings of the crop are in progress in the Circars and the Deccan. The condition of the early sown crop is generally satisfactory in the Circars and not so satisfactory in the Deccan.

The average wholesale price of cotton lint per imperial maund of 82$\frac{2}{7}$ lb. as reported from important markets on 4th September 1939 was Rs. 14—5—0 for Cocanadas, Rs. 14—13—0 for red-northerns, Rs. 13—10—0 for white-northers, Rs. 12-13-0 for Westerns (mungari crop), Rs. 14-13-0 for Westerns (jowari crop). Rs. 23-5-0 for Coimbatore Cambodia, Rs. 21-0-0 for Southern Cambodia, Rs. 20-11-0 for Coimbatore Karunganni, Rs 19-2-0 for Tinnevelly Karunganni, Rs. 17-13-0 for Tinnevellies and Rs. 17-10-0 for Nadam cotton. When compared with the prices published in the last report i. e., those which prevailed on 7th August 1939, these prices reveal a fall of five percent in the case of Cocanadas, and two percent in the case of Coimbatore Cambodia, Tinnevelly-Karunganni and Tinnevellies and a rise of one percent in the case of Westerns (Mungari and jowari) and Southern Cambodia, the prices of Northerns (Red and white), Coimbatore-Karunganni and Nadam cotton remaining stationary or practically stationary.

Statistics—Cotton—1939—40—First forecast report. The average of the areas under cotton in the Madras Province during the five years ending 1937—38 has represented 9·9 per cent of the total area under cotton in India.

2. The area under cotton up to the 25th July 1939 is estimated at 149,000 acres. When compared with the area of 284,300 acres estimated for the corresponding period of last year, it reveals a decrease of 47·6 per cent.

3. *Central districts and South—Mainly Cambodia tract.*—The area in the Central districts and the South represents generally the last year's crop left on the ground for second pickings before the plants are removed in September in compliance with the provisions of the Pest Act. The area in these districts fell from 135,100 acres to 86,500 acres. The yield is expected to be generally below normal due to insufficient rains in July.

4. *Westerns tract.*—The area under Westerns fell from 95,600 acres to 28,400 acres, i.e., by 70·3 per cent owing mainly to the want of timely and sufficient rains. The crop has been damaged to some extent by an attack of red hairy caterpillar in parts of the taluks of Adoni and Siruguppa in the Bellary district.

5. *White and Red Northerns tract.*—The area under White and Red Northerns fell from 31,500 acres to 12,000 acres, i.e., by 1·9 per cent.

6. *Warangal and Red Northerns tract.*—The area under Warangal and Cocanadas cotton fell from 15.900 acres to 15,6000 acres, i.e., by 1 9 per cent.

7. The average wholesale price of cotton lint per imperial maund of 82-2/7 lb. as reported from important markets on 7th August 1939 was Rs. 15 for Cocanadas, Rs. 14--13—0 for Red Northerns, Rs. 13—10—0 for White Northerns, Rs. 12—11--0 for Westerns (mungari crop), Rs. 14—10—0 for Westerns (Jawari crop), Rs. 23—9—0 for Coimbatore Cambodia, Rs. 20—14—0 for Southern Cambodia, Rs. 20—12—0 for Coimbatore Karunganni, Rs. 19—8—0 for Tinnevelly Karunganni, Rs. 18—4—0 for Tinnevellies and Rs. 17—9—0 for Nadam cotton.

8. Figures by districts are given below :—

(Area in hundreds of acres, i e., 00 being omitted).

District and tract.	Estimate of the area sown up to the end of		Increase (+) or decrease (−) of the area in column (3) as compared with the area in column (2).
	July 1938	July 1939	
(1)	(2)	(3)	(4)
	Acs.	Acs.	Acs.
Chingleput	...	...	...
South Arcot	4,0	6,0	+ 2,0
Chittoor	...	...	...
North Arcot	3	2	− 1
Salem	29,0	14,0	− 15,0
Coimbatore	33,0	26,0	− 7,0
Trichinopoly (including Banganapalle) ...	12,5	5,0	− 7,5
Tanjore	...	...	...
Madura	34,0	17,0	− 17,0
Ramnad	10,0	7,0	− 3,0
Tinnevelly	12,0	11,0	− 1,0
Malabar	1	1	...
South Kanara...	2	2	...
Total, mainly Cambodias including Nadam and Bourbon	135,1	86,5	− 48,6
Kurnool (Pattikonda taluk)	15,5	3,0	− 12,5
Bellary	75,0	20,0	− 55,0
Anantapur	4,5	5.0	+ 5
Cuddapah	6	4	− 2
Total Westerns ...	95.6	28.4	− 67,2
Kurnool (excluding Pattikonda but including Banganapallee)	31,5	12,0	− 19,5
Total, White and Red Northerns ...	31 5	12,0	− 19,5

Vizagapatam (Golgonda taluk)	1,8	1,5	– 3
East Godavari	5	5	Nil
West Godavari	5	3	– 2
Kistna	1,0	1,2	+ 2
Guntur	12,0	12,0	Nil
Nellore	1	1	Nil
Total, Warangal and Cocanadas ...	15,9	15,6	– 3
Chinnapatti (Short-staple)	6,2	6,5	+ 3
Vizagapatam (except Golgonda taluk) ...			
Grand Total ...	284,3	149,0	– 135,3

Statistics—1939—Ginger crop—First forecast report. The area under ginger up to the 25th August 1939 in the Malabar district is estimated at 11,300 acres as in the previous year. The condition of the crop is satisfactory.

Statisics—1939—Pepper—First forecast report. The area under pepper up to 25th August 1939 in the districts of Malabar and South Kanara is estimated at 102,300 acres (93,700 acres in Malabar and 8,600 acres in South Kanara) as against 103,400 acres (94,600 acres in Malabar and 8,800 acres in South Kanara) estimated for the corresponding period of the previous year. The yield is expected to be normal.

The wholesale price of pepper per imperial maund of 82, 2/7 lbs. as reported from important markets on 4th September 1939 was Rs. 11—6—0 at Calicut, Rs. 10—14—0 at Tellicherry and Rs. 11—0—0 at Mangalore. When compared with the prices which prevailed on the 9th January 1939 these prices reveal a fall of about 10 per cent in Mangalore and 4 per cent in Calicut and Tellicherry. (*From the Director of Industries and Commerce*).

Cotton Raw, in the Madras Presidency. The receipts of loose cotton at presses and spinning mills in the Madras Presidency from 1st February to 8th September 1939 amounted to 406,498 bales of 400 lb. lint as against an estimate of 388,900 bales of the total crop of 1938-39. The receipts in the corresponding period of the previous year were 422,554 bales. 319,678 bales mainly of pressed cotton were received at spinning mills and 169,246 bales were exported by sea while 120,099 bales were imported by sea mainly from Karachi, Bombay and Egypt.

College News and Notes.

Students' Corner. Stud nts Club-Hostel Tatler—*The Hostel Tatler*—a magazine entirely managed by the students is under circulation among the various officers of the Agricultural College and Research Institute. The students are to be congratulated on the get up of this humorous publication, which reveals a wide range of talents in all directions.

Games *Cricket :—Rhondy Shield.* The Agricultural College A team played against the local Government Arts College on 26-8-39 at the College maidan. The Government College batting first were all out for 76. Kothandaraman, was deadly with his bowling—securing 8 wickets for 14 runs. The Agricultural College put up a huge total of 221 for 5 wickets, when stumps were drawn. Messrs. H. Shiva Rao and Mohiuddin the opening pair scored 41 and 51 respectively, and retired. S. V. Srinivasan scored 57 in quick time and was caught in the end. The other scorers wese Kothandaraman 10 not out and K. S. Ramaswami 29. The Agricultural college A team thus won the match.

On 27-8-39 the Agricultural College Cricket team visited Palghat and played against the Government Victoria College. Entering first the Agricultual College team scored 161 for 8 and declared. Mr. C. Ramaswami indulged in some hefty hitting and scored a brilliant 78 when he was caught. The Government Victoria College scored 65 for 8. (Kothandaraman 5 for 26, K S. Ramaswami 3 for 15). The match ended in a draw.

A very exciting and interesting match was played on 7-9-39 between the Agricultural College and S. R. C. B. at Stanes grounds. The Agricultural College won the toss and allowed the S. R. C. B. to bat first. The S. R. C. B. were all out for 152 (Venkatachalam 35, Subbaraman 40, B. S. Krishnamurthy 23, S. V. Srinivasan 5 for 2, S. Kothandaraman 4 for 69).

Batting next the Agricultural College compiled a total of 222 for 8 and thus won the match. (C. Ramaswami scored 94 which included Eleven fours and one six. S. V. Srinivasan 43 and Mohiuddin 29.) Messrs. C. Ramaswami and S. V. Srinivasan are to be congratulated on their brilliant batting.

Foot-ball. *Inter Collegiate match.* The College Eleven played the Voorhe's College (Vellore) Eleven on 1-8-39, at the College ground and won the match by 1—0. The only goal was scored by Hanumantha Rao. On the 15th September the College team played against the Local arts college on the latter's grounds and lost the match by 0—4. The disastrous result of the match was due to the inability of some players including the captain to participate in the game.

Hockey. *Inter collegiate contest.* The College XI played the Salem XI on 23-8-31 at the College grounds and won by a big margin of 6—0.

In the match played against Voorhes' College XI on 3-9-39 at our grounds the College XI won by 3--0.

The match between the College XI and the Government Arts college played on 9-9-39 was marred by an unfortunate incident. As no goal was scored in the full time, extension was granted, and in the first half of the extended time, the College XI scored 2 goals in quick succession. Another goal was scored in the second half and when the fourth goal was about to be shot, 2 minutes before the time, a melee of players ensued, inside the ring of the Government College goal. As game could not be resumed owing to the refusal of the Arts College players to continue, the umpire blew the whistle and declared the Agricultural College as winners.

Michaelmas Holidays. The September terminal examinations are over and the college is closed for students from 16-9-39 to 3-10-39. Some members of the Students' Club have left on a games tour to Tellichery, Cannanore and Mangalore on 15-9-39, and they are expected to participate in Tennis, Cricket and Hockey Matches.

Officers' Club The Annual Club Day will be celebrated on Saturday the 21st October 1939. The Club Day sports and tournaments are being conducted.

Personal. We are glad to learn that Mr. T. K. Thangavelu, A. D., Ooty has been awarded medal for his improved turmeric Polisher by the I. C. A. R.

Situations Vacant.

Messrs. Begg Sutherland and Company Limited, Cawnpore, has vacancies for a number of Assistant Sugarcane Entomologists to carry out work on pest control in their sugarcane areas in the United Provinces and Bihar.

The qualifications required are a good *Honours* Degree in Science, with Agriculture, Botany and Zoology as the principal subjects. A knowledge of Entomology is desirable and some acquaintance with statistical methods of field experiments. The work will mainly consist in the collection of field data and applying methods of pest control under direction, and it is desirable that candidates should have experience and a liking for this type of work. The salary on appointment will be Rs. 130 p. m. rising to Rs. 150, together with travelling allowance and free quarters. Successful candidates will be required to join the Company's Provident Fund. A knowledge of sugarcane pests is not essential, but what we want is a type of man who is young and keen, with a sound training in Scientific methods and a liking for this kind of work. Graduates who have just come down from the University will be considered, as well as those with some experience of post-graduate research. Applications should be forwarded with copies of testimonials.

Weather Review—AUGUST 1939.

RAINFALL DATA

Division	Station	Actual for month	Departure from normal @	Total since January 1st	Division	Station	Actual for month	Departure from normal @	Total since January 1st
Circars	Gopalpore	3·1	-4·2	15·7	South	Negapatam	1·0	-2·5	19·3
	Calingapatam	2·2	-4·7	13·5		Aduthurai *	3·9	+0·6	20·4
	Vizagapatam	1·8	-3·6	11·7		Madura	3·2	-1·1	18 0
	Anakapalli *	2·0	-3·4	10·1		Pamban	0·3	-0·4	8·6
	Samalkota *					Koilpatti*	0·0	0 0	0·0
	Maruteru *	4·2	-3·3	13·1		Palamkottah	1·1	+0·6	6·1
	Cocanada	5·6	0·0	17·5					
	Masulipatam	3·2	-3·5	11·8					
	Guntur*	3·7	-1·6	11·6	West Coast	Trivandrum	6·6	+2·5	42·7
						Cochin	11·3	-1·0	96·8
Ceded Dists.	Kurnool	4·3	-0·9	9·3		Calicut	15·3	0 0	93·3
	Nandyal*	0·0	0·0	0 0		Pattambi *	15·3	+1·1	76·9
	Hagari *	5·8	+2·6	10·5		Taliparamba *	14·9	-8·4	99·6
	Siruguppa*	7·4	+3 9	11·9		Kasargode *	23·5	+0·3	104·0
	Bellary	3·2	+1·0	7·5		Nileshwar*	29·0	+4·2	100·9
	Anantapur	4·8	+2·0	11·4		Mangalore	19 6	-3·6	99·1
	Rentachintala	3·2	...	10·9					
	Cuddapah	2·0	+3·8	8·1					
	Anantharajupet *	1·0	-2·2	11·3	Mysore and Coorg	Chitaldrug	8 8	+5·8	20·7
						Bangalore	3·5	-1·9	18·3
						Mysore	3·3	0·0	14·9
Carnatic	Nellore	1·0	-2·1	7·9		Mercara	26·7	-1·2	79·5
	Madras	0·8	-3·7	9·4					
	Palur *	2·6	-2·2	16·4					
	Tindivanam *	2·4	-3 5	12·5	Hills	Kodaikanal	6·4	-0·6	27·9
	Cuddalore	3·9	-1·5	20·8		Coonoor			
Central	Vellore	0·4	-5·4	12·0		Ootacamund *	8·8	+0·6	30·1
	Salem	8·1	+1·6	25·6		Nanjanad *	8·7	+1·8	27·8
	Coimbatore	2·2	+1·1	8·0					
	Coimbatore A. C. & R. I.*	3·1	+1·9	8·8					
	Trichinopoly	3·6	-0·3	18·2					

*Meteorological Stations of the Madras Agricultural Department.

@ From average rainfall for the month calculated upto 1935 published in the Fort St. George Gazette.

The monsoon was active throughout the month. It was vigorous in Bengal, strong in the central parts of the country and Hyderabad and generally active in the West Coast.

Four depressions in the Bay of Bengal were responsible for the widespread rainfall. Some locally heavy falls occurred in the Deccan and Central districts. Rainfall was in excess in the Ceded districts, parts of West, South and Central districts and in defect elsewhere.

Skies were moderately to heavily clouded in the Konkan, parts of Malabar, Mysore and parts of the Madras Presidency; and lightly to moderately clouded in the North Madras Coast and Madras Deccan. Humidity was in excess in Malabar, Konkan, and the Madras Deccan and in defect in South East Madras and North Madras Coast.

The maximum temperatures were above normal in North Madras Coast, Mysore and South East Madras and in defect elsewhere. Nellore and Cuddalore recorded the highest maximum of 108°F on the 9th.

Chief amounts of rainfall.

Mangalore	4·5″	...	6th.
Salem	6·9″	...	7th.
Chitaldrug	4·3″	...	10th.
Hagari	3·9″	...	10th.

Weather Report for Agricultural College and Research Institute Observatory.

Report No. 8/39.

Absolute maximum in shade	...	92·0°F
Absolute minimum in shade	...	66·5°F
Mean maximum in shade ...	...	86·6°F
Departure from normal ...	...	-0·3°F
Mean minimum in shade ...	...	72·6°F
Departure from normal ...	...	+1·5°F
Total rainfall for the month	...	3·1″
Departure from normal ..	...	+1·9″
Heaviest fall in 24 hours ...	...	1·7″ on the 11th.
Number of rainy days ...	...	6
Mean daily wind velocity ...	...	7 miles per hour.
Departure from normal ...	...	Nil.
Mean humidity at 8 hours ...	...	70·7%
Departure from normal ...	...	-3·3%

Summary. Weather was slightly unsettled during the 2nd week of the month, but otherwise practically dry. A total rainfall of 3·1 inches was received during the month of which 1·7 inches were received on the 11th. The rainfall was in excess by 1·9″. Skies were moderately to heavily clouded and the humidity was in large defect. The mean maximum temperature was very slightly below normal while the mean minimum was above normal. P. V. R. & F. L. D.

Departmental Notifications.

Gazette Notifications.

Transfers.

Name of officers.	From	To
Sri R. Swami Rao.	Asst. D. A., Cuddalore,	Asst. D. A., Madras.
„ E. K. Nambiar,	Offg. Asst., D. A., Madura,	Gazetted Asst. to the Principal, Agri. College, Coimbatore.
„ M. Kanti Raj,	Asst. to the Principal, Agri. College, Coimbatore,	Junior Lecturer in Agriculture.
„ S. Kasinatha Iyer,	Temporary Bio-chemist, Coimbatore.	Offg. Asst. Agricultural Chemist, Coimbatore.
„ G. Ganapathy Iyer,	Offg. Asst. Agricultural Chemist, Coimbatore,	Asst. in Chemistry, Coimbatore.
„ Samuel Jobitha Raj,	Supdt. A. R. S., Pattambi,	Offg. Asst. D. A., Madura.

Subordinate Services.

Appointment.

Janab Muhammad Ali Sahib, Agricultural Demonstrator, Puthur, in III grade (new) is appointed as Upper Subordinate, Agricultural Section, I Grade (new) on Rs. 145 in the new revised scale of Rs. 145-15-2—190 with effect from 15th August 1939 in an existing vacancy.

Promotions.

The following substantive and provisionally substantive promotions of upper subordinates in the Agricultural section are ordered with effect from 15th August 1939:—

Substantive Promotions:—

Sri B. Shiva Rao, from II grade to I grade Rs. 250.

Messrs V. Ratnaji Rao, S. R. Srinivasa Ayyangar and T. G. Anantarama Ayyar from III grade to II grade Rs. 225.

Messrs K. Avudainayagam Pillai, V. N. Subbanacharya and D. Panakala Rao, from IV grade to III grade Rs. 200.

Messrs S. Viravardaraju, V. K. Kunhunni Nambiar and K. P. Sankunni Menon. from V grade to IV grade Rs. 120-10—170.

Provisionally Substantive Promotions:—

Messrs A. Gopalan Nayar, M. P. Kunhikutti, and K. Govindan Nambiar from II grade to I grade Rs. 250.

Messrs D. Panakala Rao, A. Ramaswami Ayyar, M. A. Balakrishna Ayyar and V. T. Subbiah Mudaliar from III grade to II grade Rs. 225.

Transfers.

Name of officers	From	To
Sri M. Somayya,	F. M., A. R. S., Nandyal,	A. D., Yellamanachill.
„ M. Bhavani Shanker Rao,	Asst. in Oil Seeds,	A. R. S., Tindivanam.
„ V. S. Rangacharlu	A. D., Bellary,	F. M., A. R. S., Kodur
„ S. Dharmalingam Mudaliar,	Asst. in Paddy Section, Coimbatore,	Asst. in charge of A. R. S., Pattambi.
„ T. K. Balaji Rao,	Asst. in Paddy, A. R. S., Aduturai,	Asst. in charge of A. R. S., Aduturai
„ M. B. Venkatanarasinga Rao,	Asst. in Paddy, A. R. S., Meruteru,	Asst. in charge of A. R. S., Maruteru
„ K. Hanumantha Rao,	Asst. in Oil Seeds, A, R. S., Kasargode,	A. R. S., Pattambi.
„ K. Saptharishi,	Asst. in Chemistry, Coimbatore,	A. R. S., Aduturai.
„ K. Bhushanam,	Offg. Asst. in Chemistry, Coimbatore,	A. R. S., Anakapalle.
„ P. Krishnamurthy,	F. M., A. R. S., Anakapalle,	A. D., under training Narasannapet.
„ N. H. V. Krishnamurthy,	F. M. Anakapalle,	Asst. in Paddy, A. R. S., Maruteru.
„ G. Sakharama Rao,	A. D., Udipi,	A. D., Moodubidri.
„ K. S. Ramanna Rai,	A. D., Moodubidri,	A. D., Udipi.
„ C. Raman Moosad,	A. D., Ponneri,	A. D., Manjeri.
Janab P. Abdulla Haji Sahib,	A. D., Manjeri,	A. D., Ponneri.
Sri M. P. Sankaran Nambiar,	A. D., Calicut,	A. D., Dharapuram.
„ N. K. Thomas,	A. D., Dharapuram,	A. D., Calicut.
„ A. P. Balakrishnan Nayar,	A. D., Tiruchengode,	A. D., Omalur.
„ P. M. Appaswami Pillai,	Asst. A. D., Omalur,	A. D., Attur.
„ N. Narayana Ayyar.	A. D., Attur,	A. D., Tiruchengode.
„ M. Suryanarayana Ayyar,	A. D. in Mycology in Cuddalore,	To undergo training in *Entomology, Coimbatore.*

,, C. Krishnamurthy,	Offg. Asst. Entomology under training,	A. R. S., Anakapalle.
,, B. M. Pinto,	Offg. A. D., Hospet,	Asst. in Oilseeds, Kasargode.
,, Adiseshaiah,	Undergoing training at Gudiyatam,	A. D., Vellore.
,, K. B. Vytheswaran,	A. D., Chengam,	A. D., Vellore.
,, N. Venkaiah,	A. D. under training (Kavali),	A. D , Kandakur.

Leave.

Name of officers.	Period of leave.
Sri Seshadri Ayyar, A. D., Perambalur.	L. a. p. for 3 months from the date of relief.
,, C. S. Balasubramaniam,	L. a. p. for 1 month from 11-7-39.
,, R. Krishnamurthy, A. R. S., Nandyal,	L. a. p. for 2 months for 12-8-39.
,, P. Israel, I. C. A. R., Asst. in Entomology, Coimbatore,	L. a. p. for 30 days from 4-9-39.
,, R. Govinda Ramaya, A. D. (on leave),	Extension of l. a. p. for 1 month from 21-8-39.
,, M. Jivan Rao, F. M., F. R. S., Kodur,	L. a. p. for 3½ months from 8-9-39.
K. M. Jocob. A. D. (on leave),	Extension of l. a. p. on m. c. for 4 months.
Sri C. Jagannatha Rao. Asst. in Cotton. A. R. S., Nandyal,	Extension of l. a. p. for 20 days from 3-9-39.
,, P. Ramanadha Rao, A. D., Atmakur,	L. a. p. for 10 days from 17-8-39.
,, K. Krishnan, A. D (on leave),	L. a. p. for 2 months from 11-8-39.
,, M. Subba Reddy, A. D., Rayachoti,	L. a. p. for 2 months from 6-9-39.
,, K. S. Krishnamurthy Iyer, A. D , Trichinopoly,	L. a. p. for 1 month and 3 days from 28-8-39.
,, L. Krishnan, A. D,. Tanjore,	L. a. p. for 15 days from 8—9—39.
,, Rajagopala Ayyangar. Asst. in Chemistry, Coimbatore,	L. a. p. for 1 month from 6-9-39.
,, S. Madhava Rao. F. M., Horticulture, Central Farm, Coimbatore,	L. a. p. for 16 days from 31-8-39.
,, S. Mayandi Pillai, A. R. S., Nandyal,	L. a. p. for 2 months from 13-8-39.
,, C. S. Namasivayam Pillai, Asst.. A. D., Nanguneri,	L. a. p. for 20 days from 18-9-39.
,, G. Venkataratnam, A. D., Chodavaram,	L. a. p. for 25 days from 6-9-39.
,, A. P. Balakrishna Nayar, A. D., Tiruchendgode,	L a. p. for 2 months from 21-9-39.